WORK

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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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PIT-FRAME FOR WHEEL MAKING.

BY PETER WILLIAMSON.

A WHEEL-FRAME or pit is a necessity to a wheelwright's or coachbuilder's shop. How a wheeler could make a wheel without this indispensable article it would not be easy to imagine. There are three differently made frames, but all are nearly similar in appearance, the only difference being the way in which they are fitted up. The primitive frame was, indeed (as its name implies), a pit-frame, and is still, I believe, used in some parts of the country yet. It is something similar to a sawyer's sawing-pit, only, of course, very narrow. A pit was dug 5 ft. long by 1 ft. wide, and 1 ft. deep; four posts were driven in, and the top was made exactly the same as the one I am going to describe 2 ft. high from the ground.

But this pit being a fixture in the shop or yard, it took up too much room, so, therefore, it has given way to a more convenient one, which I will describe, and show you how to make one exactly the same as I have, and on which I have made hundreds of wheels. It can be carried about by two men, and when not in use and there is no room to spare in the shop, it can be put outside in the yard, as I have kept mine out in all weathers, in summer and winter; and it appears to be as strong (although it is not painted) as it was when first I made it years ago.

The top of the frame which I have has apparently been the trunk of an ash sawn in two, as the under part and sides are just a little round, where the bark has been peeled off. I merely mention this to show that the top only is required to be straight and square, and also the sides a little, but, if the top be all of one width, so much the better.

In the first place we shall require two long lengths of ash or deal. If of ash, it should be $3\frac{1}{2}$ in. thick; if deal, 4 in. thick. These two pieces must be 6 ft. 4 in. long, 7 in. wide, and $3\frac{1}{2}$ in. thick; two swords 2 ft. by 3 in. by $1\frac{1}{8}$ in. of ash or oak; four legs, $2\frac{1}{2}$ ft. high by $2\frac{3}{4}$ in. square, also of oak or ash. These measurements are just as I have measured, so that you must allow for sawing and planing. Get your jack plane and smooth the two large pieces at the top and sides, also your swords. Then lay your large pieces or top on your bench both together in a line, put your swords upon the top, about 3 in. from each end of the large pieces, and mark with pencil each side of sword on the frame top.

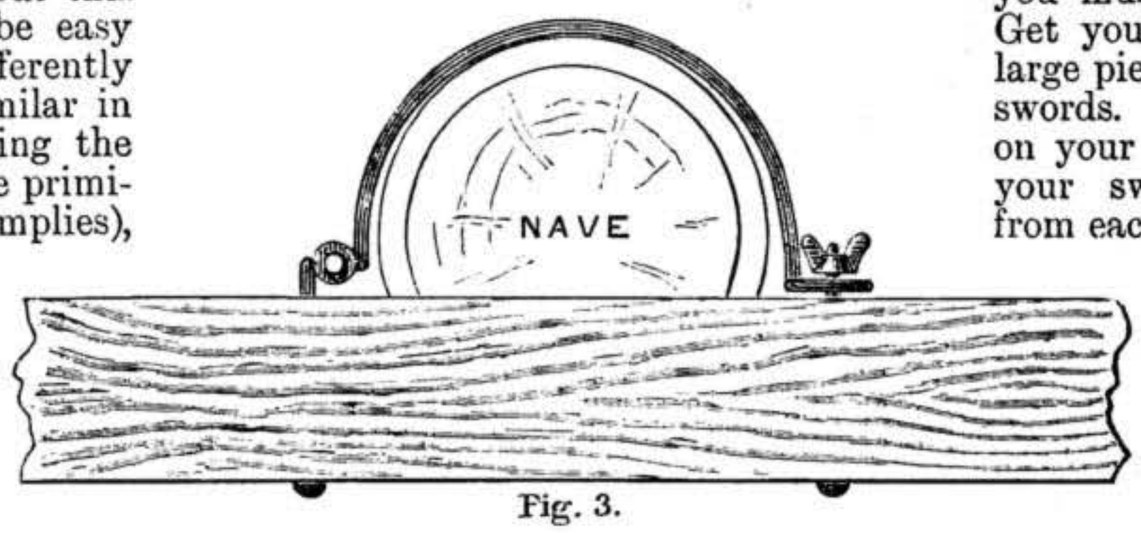

Fig. 3.

We now get the large piece and square down the sides from the pencil line. When we have served all the four sides alike, we set our gauge and mark for the mortise. This mortise must be 3 in. by $1\frac{1}{8}$ in. wide: bore first with $\frac{3}{4}$ in. bit, then mortise out with a sharp paring chisel. Knock in your swords; do not fit them in slack, and they must not be fastened in the frame, as it sometimes has to be drawn out when mortising a large nave, or pushed together when a small phaeton wheel is being made.

We now roughly plane up the four legs, then mortise in the frame, letting the legs come through level with the top of frame. They are mortised in about 15 in. from each end of frame. You will see that the legs stand out all round. Now find the centre of frame, and hollow it out; or get a nave, one of medium size; mark round with pencil; hollow this out a little at its lowest depth, say $1\frac{1}{4}$ inch. We now mortise four holes on the top of frame 3 in. by 1 in. wide; these must not be in a straight line, but slanting as Fig. 1. The space between the mortises

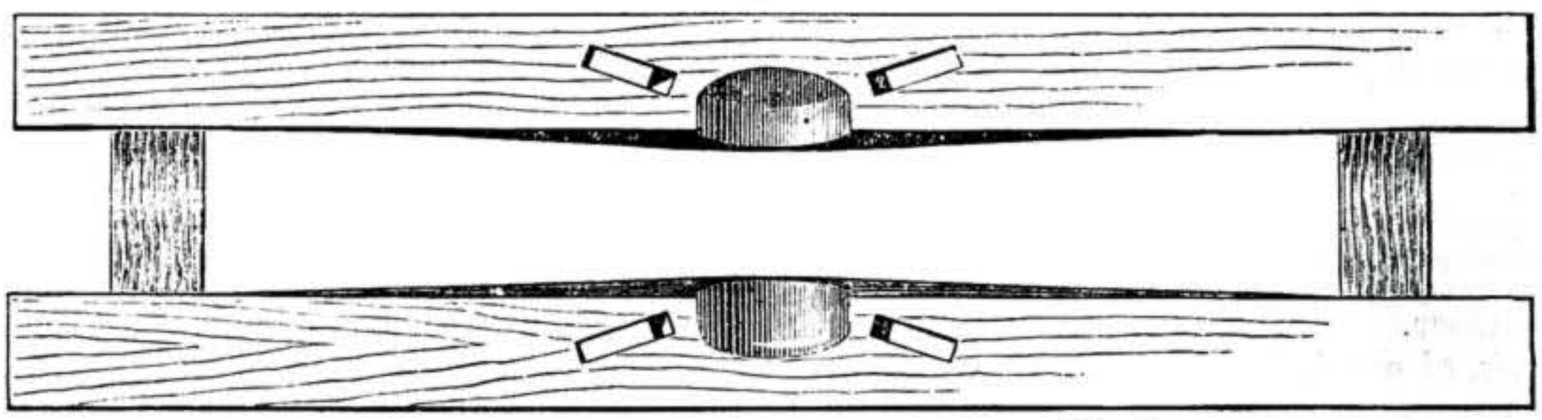

Fig. 1.

Fig. 2.

Fig. 2A.

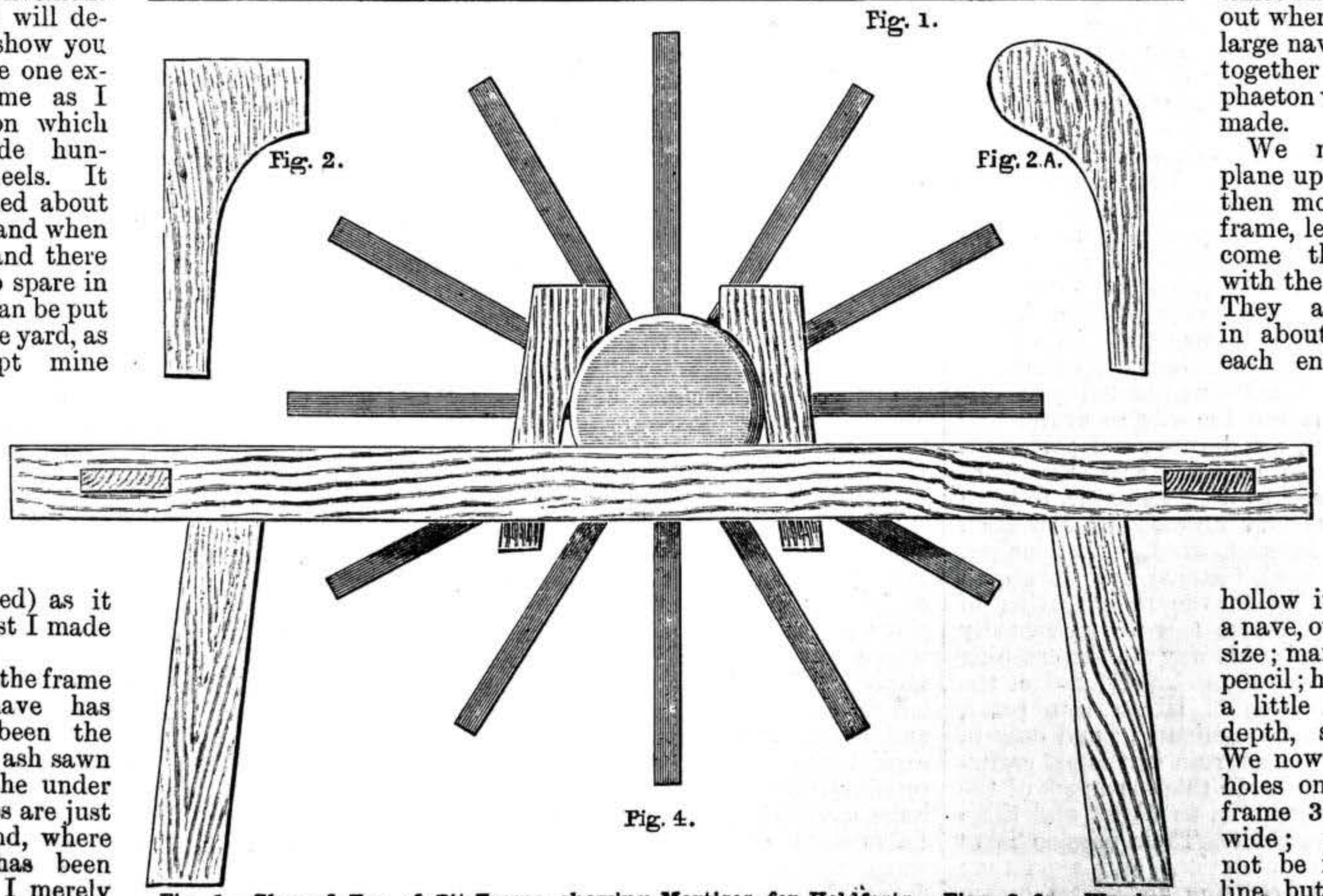

Fig. 4.

Fig. 1.—Plan of Top of Pit-Frame showing Mortises for Holdfasts. Figs. 2, 2a.—Wooden Holdfasts to hold Nave. Fig. 3.—Nave held on Frame with Iron Holdfast. Fig. 4.—Front Elevation of Pit-Frame, with Nave and Spokes in Position.

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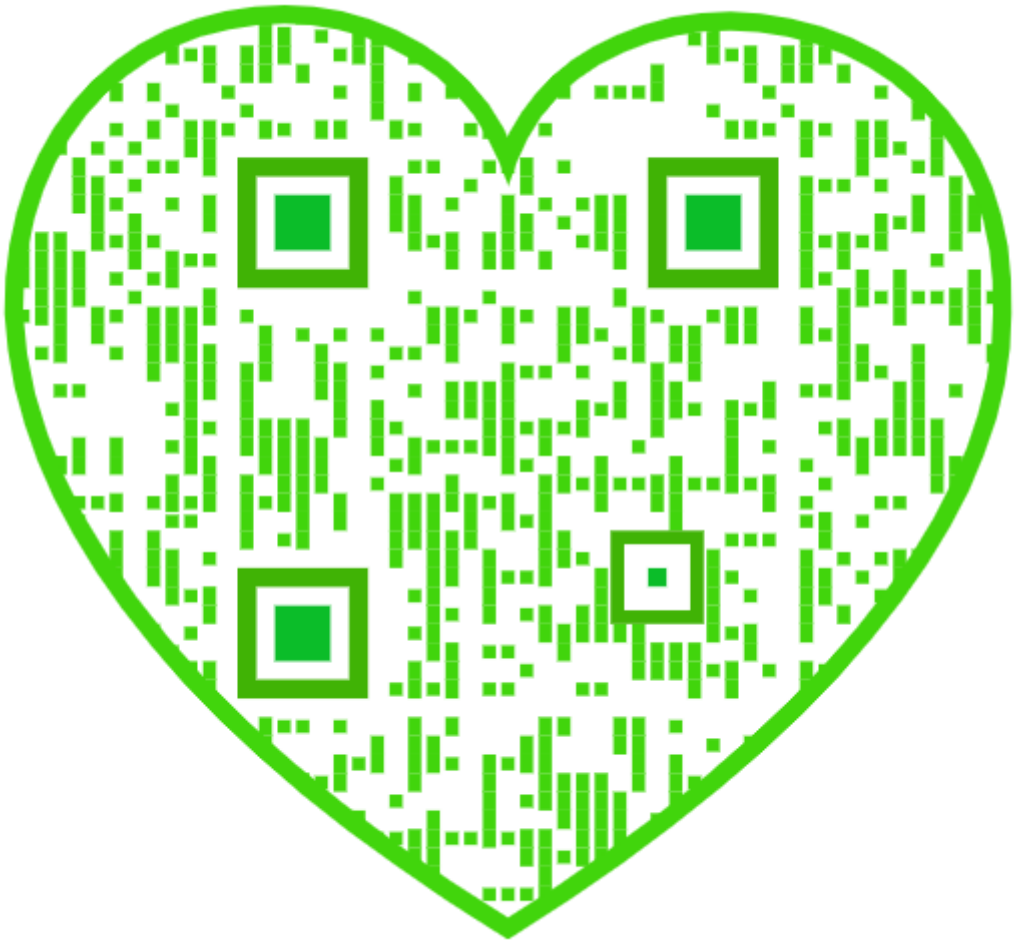

must be 6½ in.: these mortises are to be fitted with four holdfasts, as in Fig. 2, or 2A. These are of ash, the size of them being 20 in. long, full ¾ in. thick, 2¼ in. wide at the foot, getting thicker and wider at the top. Instead of these holdfasts, some wheelers have an iron band or hinged clamp which fits half way over the nave to hold it fast in its place whilst it is being mortised. At one end there is a thumb-screw which, when unfastened, allows the nave to be turned round. These iron holdfasts (Fig. 3) are fixed where the fret or hoop will be when in its place on the nave.

The pit-frame which I have been describing, and which is shown in Fig. 4, is, I think, the one which is most approved of, as the wheeler can get at the wheel all round. The third kind of frame is made exactly like Fig. 4, only half of it being fixed to the wheeler's bench. It is a piece of deal or hard wood, 6 or 7 ft. long, with two legs mortised into the top of frame. This half of frame must be quite level with top of bench. Two swords are then fixed upon the top of bench and frame. A 2-in. slot 1 in. from each end of sword is mortised for thumb-screws to work in, or holes can be bored in the sword every inch or so to allow the screws to be put in to tighten and keep the frame together. Two holes are mortised in the bench, and also a little wood hollowed out, to bed the back end of nave. This kind of a pit-frame certainly is a very convenient one, as it does not take up much room, and when not in use can be put at one side until again required.

SMITHS' WORK.

BY J. H.

(*Continued from page* 199.)

CAUSES OF LACK OF TALENT, ETC.—MISTAKES IN EDUCATION—LOWEST POINT OF SMITHS' WORK RENAISSANCE OF MECHANICS—AGE OF MACHINERY—CAPITAL AND LABOUR.

ONE main cause, as I think, of our lack of talent and originality in conception and execution is that our common methods of training do not sufficiently *educate*—draw out the latent faculty of the mind. Our training is imitative rather than originative; it is mechanical, not creative. There is such a thing as mechanism of the intellect as well as of the hands. Instead of training the inventive faculties and encouraging the plastic minds of the young to follow the bent of their own individual genius, we give to them set tasks, too often destitute of animating life, divorced from ideals, and say in effect, "Learn these; do these things, and you will become educated." But cramming with undigested and disjointed facts is not the way to evolve and nurture genius, art, beauty, and perfection in design and work. After centuries of pedagogy we are, so it seems to me, to learn the whole art and mystery of education over again. Interest, devotion, originality, must be awakened, fostered, and developed ere we shall behold the revivification of the fair ideals whose loss we unfeignedly deplore. Only in this way can the crushing effects of the use of machinery, and of the consequent division of labour into petty, paltry sections, be eliminated; and only in this manner can the ruin of the old craftsmen be retrieved. In this lies much of the value of such journals as WORK and those of kindred character. Their mission is to awake brighter ambitions and aims than those at present existing, and to teach men those principles which underlie the practice of their crafts, and which in the modern workshop are not made a necessary part and parcel of their training.

I think we may regard the eighteenth century as being the nadir of industrial skill. The old race of craftsmen had mostly become extinct, the new race had not yet arisen. Hand-work had been neglected, machine-work was not come to the birth. The inventions of the last century demanded an excellence of workmanship which it was impossible to procure by any means. Bramah, Maudsley, Holtzapffel, and other contemporaries were in their infancy. Watt, writing to Dr. Roebuck, says: "You ask what is the principal hindrance in erecting engines? It is always the smith-work." His first cylinder was made by a whitesmith, of hammered iron soldered together; but having used quicksilver to keep the cylinder air-tight, it dropped through the inequalities into the interior, and "played the devil with the solder." Yet, inefficient though the whitesmith was, Watt could ill spare him, and we find him writing to Dr. Roebuck almost in despair, saying, "My old white iron man is dead," feeling his loss to be almost irreparable.

Watt continually complained of the failure of his engines through "villainous bad workmanship." Writing once to Dr. Small respecting a cylinder 18 in. diameter, he said at the worst place the long diameter exceeded the short by *only* ⅜ in. Brunel could not for a long time get mechanics sufficiently skilful to construct his block-making machines.

But the great mechanicians of the eighteenth and nineteenth centuries have by their inventions completely revolutionised the character of our mechanical industries. Bramah, Maudsley, Penn, Clement, Nasmyth, Roberts, Fairbairn, and Whitworth are names to be held in everlasting honour They are the creators of the Renaissance of mechanics, names familiar to the cultured workmen as household words. Yet although we live in the Renaissance of mechanical skill, it is not skill of the same character as that which gave a lustre to the early and mediæval Christian centuries. The skill we boast of now is of an essentially different kind from that whose loss we deplore. We live in an age of machinery. With machinery there has come division of labour, perfection, and cheapness, at the sacrifice of individuality and of real artistic skill. The artist is crushed beneath the wheels of the car of our modern Juggernaut, the great god Mammon. A workman who sought conscientiously to emulate the old craftsmen would be undersold in the market, and starve by reason of the rage for cheapness.

The cause, therefore, of the decay of artistic craft lies deep down in the foundations of our social life. Master and man, with their living personal relations, have yielded place to "capital" and "labour," with their cold impersonalities. How much is involved in that! In the great and silent revolution that has taken place, the artist craftsman, member of a proud guild, has given place to the mere "hand," the unionist, whose watchwords are the "three eights." Capital accumulates enormous fortunes; labour shuffles wearily through its tasks, and longs for the sound of the last bell; capital has become synonymous with a proud abstraction; labour is a portion of a huge machine by which capital is created. Labour is divorced alike from both wealth and art. The beauty of ideality has departed from every-day tasks; and life's work is brutish without ideal, ambition, and glimpses of the spiritual and intellectual.

THE SAW: HOW TO USE IT.

BY J. H.

(*Continued from page* 162.)

TROUBLES IN SAWING—SAW STICKING IN WET WOOD—DIFFICULTY WITH HARD THIN WOOD—SPECIAL SAWS FOR SPECIAL WORK—TENON SAW—DOVETAIL SAW—CROSS-CUT SAW—LINING OUT—TIMBER FOR CUTTING—ATTITUDE IN SAWING WITH HAND SAW—ANGLE OF SAW—KEEPING SAW UPRIGHT—REMEDY FOR EVILS—HOW TO USE TENON SAW.

HAVING now clear ideas respecting the proper form of tooth for the common hand saw, we can presently pursue our subject further, taking examples from the saws of other types. But first let us note the method of action of the hand saw.

If we try to cut down a piece of wet plank with a hand saw, we shall encounter great labour and difficulty in doing so. If we attempt to cut across the grain—that is, transversely to the direction of the fibres—the difficulty will be much increased; and if the stuff is of considerable thickness the saw will stick fast, so that it will be impossible to move it in its kerf. If we attempt to use the same saw on thin and hard wood we shall meet with trouble of another character. The teeth will hitch in the wood, the saw will sway too loosely and freely in the kerf, and, if we cut across the grain, the timber will become broken or spalted out. Obviously, therefore, different materials require different forms of saw teeth, and the teeth of the hand saw are only a kind of compromise between extreme forms, in order to enable the saw to do work of an average range.

There are two reasons why the saw sticks in soft wet wood. One is that the kerf is not wide enough, the other is that the sawdust cannot get away with sufficient rapidity. Hence the remedy is to increase the set and to enlarge the spacing, which means an increase of the pitch or centres of the teeth, with a consequent increase in the sizes of the teeth themselves.

The principal reason why the hand saw does not operate sweetly in hard thin wood is because there is too much set, and, in a lesser degree, because the teeth are too coarse and too wedge-like in form. Hence, diminish the set and spacing, and alter the rake. In hand saws which are used exclusively for soft or for hard woods, these modifications are made, a kind of intuitive knowledge begotten of experience and observation guiding the workman in the selection of the forms best adapted for any class of materials. When the limits of average work are passed, special saws are used, one saw being kept for ripping and another for cross cutting, each being of a different and distinctly marked type from the other. Then, again, according as a man works habitually in soft or in hard woods will the forms of these be slightly different. Fig. 8 shows the average forms of teeth of ripping saws used exclusively for cutting soft wood with the grain; Fig. 9 those for hand saws for general use on hard wood; Fig. 10 those of cross-cutting hand saws used chiefly on planks and boards of soft wood. In Fig. 8 the teeth are of an acute wedge-like form, having much penetrative power, and the teeth are so pitched that there is ample space between them to receive and carry away the coarse, fluffy sawdust. In Fig. 9 the teeth faces are set back, having little penetrative power, while there is yet sufficient interspace for the fine powdery dust removed from hard wood. In Fig. 10 the teeth are also set back, in order not to hitch in the grain fibres, and the amount of set is

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so large that the kerf is made sufficiently wide for the saw to pass freely between the severed and roughened-up fibres of the end grain.

Should any one question the effect of these apparently minute differences in form and set of teeth, let him try to cross cut any wood, soft or hard, with the ripping saw (Fig. 8), or to rip soft wood with the cross cut (Fig. 10). In the first case the saw would hitch perpetually, causing painful jar to the hands, and finally refuse to penetrate beyond a certain depth. In the second the labour to be expended would be excessive, and the saw would wobble about in a kerf of unnecessary width.

The remarks which apply in the main to saws of the hand-saw type will also apply in principle to all other forms. But in some the differences are more marked than in others.

The common tenon saw has more or less both of set and rake, according to the material upon which it is chiefly used. Usually it is set and sharpened in a medium or average style for general bench use. But according to the character of the

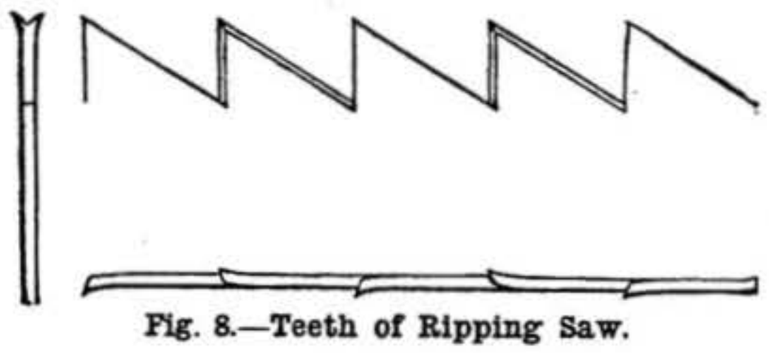

Fig. 8.—Teeth of Ripping Saw.

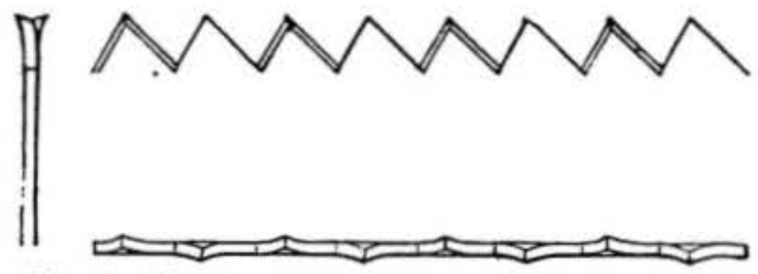

Fig. 9.—Teeth of Hand Saw for Hard Wood.

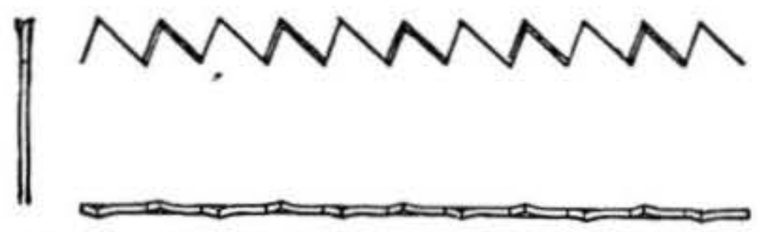

Fig. 10.—Teeth of Hand Saw for Cross Cutting.

work mainly done the size of the saw selected is from the 12-in. or 14-in. "tenon," to the 6-in. or 8-in. "dovetail," the teeth in the latter case being so fine that the thinnest wood and the most delicate joints can be cut without risk of tearing out the grain. In the large frame, pit, and circular saws, the tooth forms are often very much gulleted, to afford ample clearance space for the escape of the dust, while the angles, rake, and set are subject to much variation with the different qualities of timber operated on. In the two-handled "cross cut" the teeth are modified to cut in both directions, a form which is improved upon in the saws with M teeth.

A saw that is set and sharpened to be best adapted for its special work is much easier to use than one not so suitably adapted thereto. But, beyond this, there is art involved in the correct use of any saw, and the following notes thereon may be of service.

First, as to lining out. The chalk line, pencil, and scribe are variously used for the marking of the lines by which the saw is guided. The first-named is used for long pieces of timber, the second for ordinary and roughly approximate work, the third for the most accurate sawing.

In the first case a piece of fine cord is whitened with a lump of chalk, and being strained taut between two points whose positions are marked to correspond with the terminations of the line of cut, the chalk line is lifted vertically at or near the central portion, and being suddenly released, transfers to the timber a portion of the chalk, so marking a perfectly straight and fine line upon the timber, which thus furnishes a correct guide to the saw.

In the second, the pencil is used to mark lines for rough sawing, as when cutting short lengths from board, or cross cutting boards or planks.

In the third, lines are marked with the timber scribe, as in squaring the ends of planed stuff and in marking dovetails and tenons. The saw may then be made to cut close outside the scribed line, allowing just sufficient margin of material to be removed with the plane; or the saw may pass right along the scribed line, as in cutting dovetails and tenons, no after-finish being required. In either case the scribed line is preferable to the pencil-marked one, because the cutting can be done much more accurately in the first case than in the last. Also, when the end of a piece of timber has to be squared with the plane, there is, besides the greater accuracy, much less risk of spalting or breaking out of the grain occurring with scribed lines than with pencil-marked lines. In the case of planed ends, a careful workman will also contrive to saw extremely close to the scribed lines, in order to diminish as much as possible the labour of planing.

When cutting with the hand saw there is a certain orthodox kind of attitude generally assumed. The workman stands alongside the stuff, laid upon low sawing stools or trestles, steadying the board, if light, with his right knee, holding the saw in his right hand at an angle of about 65°, and steadying the edge of the board near the saw with his left hand. This position is, on the whole, the best, though many men are skilful in the use of the saw in another fashion. Sitting on the board, they hold the tool with both hands, in an approximately vertical position, and cut rapidly towards themselves, moving backwards with the advance of the saw. The general practice is, however, that first named, and is that in which the greatest power can be exerted and the most accurate sawing done.

The angle of about 65° at which the saw is held is also that which is best on the whole. If the saw is much more inclined, it cannot be advanced so rapidly through the wood; if much less inclined, the workman is forced to assume a somewhat constrained, bending-over kind of position, and the guidance is scarcely so good. Young apprentices usually err at the beginning by giving too much inclination to the saw.

Another point equally important is to keep the saw plumb in a direction transversely to the direction of the cut. Here the tendency is unconsciously to pull the saw towards oneself, causing the cut edge to become other than at right angles with the face of the board; and the canting over is usually not even uniform in unskilful cutting, but varies at every few inches, so that when the edges have to be planed, the timber may probably not hold up to the required width. Then, again, the cut will become wavy in the direction of its length, rendering a moderate allowance for planing insufficient.

The only remedy for these evils is care and practice at the commencement of sawing. The eye should be cast down the blade in order to judge whether or no it is plumb over the line. The attention must be specially directed to this point during the first few strokes of the saw, since to begin right is half the battle. A saw having an excess of set is more difficult of initial guidance than one having a proper amount.

When the saw has once fairly started the cut to a distance equal to the width of, say, its own blade, the risk of departure from linear accuracy is diminished. But even then the tool is apt to "run" by reason of momentary inattention, or by reason of a faulty setting or sharpening of the teeth more to one side than the other, and then the saw will have to be gradually and gently coerced into the right path, slight pressure and twist being imparted from the handle during cutting.

In ordinary sawing the workman bends over the board, not, however, in a too constrained position; and though the strokes of the saw are properly given to the full range permitted by its length, the workman does not sway his body to the same extent as the saw, which would be extremely tiresome, but directs the strokes mainly from the shoulder. The more free and unconstrained the attitude, the greater will be the amount of work got through.

Speaking generally, it will be found that the angle 65° given as the average angle for sawing will be varied with advantage in different materials. Of course, workmen do not measure the angle. I only give it as an approximate guide for beginners, who usually go wrong here. In thick stuff it will be found that there is advantage gained by keeping the saw slightly nearer the vertical, and in cutting thin stuff it may be slightly more inclined. In thin stuff the kerf affords less guidance to the saw than in deep stuff, and the wood is more likely to break out, especially in cross cutting. Hence the reason for the greater inclination.

The tenon saws are generally used at a very slight inclination only with the line of cut often almost parallel; there is then little risk of broken edges. A panel saw will cut much more rapidly than a tenon saw, and should be used in preference for cross cutting of ends and shoulders in quantity; and with fine teeth uniformly set and sharpened, there is practically no risk of broken edges.

After skill in the use of the hand saw and cognate types, facility in that of the smaller saws follows as a matter of course. Similar principles apply to each; matters of set, rake, sharpening, and guidance are pretty much alike, whether we use the large saws or the smaller bow, compass, or keyhole saws, and the principles of operation are alike in all.

THE TENANT'S GREENHOUSE.

UNATTACHED TO THE SOIL AND REMOVABLE AT PLEASURE.

BY GEORGE LE BRUN.

(*Continued from page* 212.)

COMPLETION OF STRUCTURE—BARGE BOARDS AT ENDS—ALTERATIONS IN DETAILS—FILLING UP WITH BRICKWORK—BOARDING FILLED WITH SAWDUST — VENTILATION BY FANLIGHTS IN ENDS — ROOF VENTILATION — ORNAMENTAL CRESTING FOR RIDGE—CONCEALMENT OF SILL —STOP CHAMFERING OF POSTS—GREENHOUSE ON FLAT ROOF.

WITH the completion of the work, as described in the previous papers, the house is finished, at least, so far as the joiner's work is concerned, and only requires glazing and painting to fit it for the reception of the

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plants. It presents the appearance shown at Fig. 9 (see No. 12, p. 177), in which the alternative method of diagonal match-boards and Gothic-headed sashes are shown.

To further improve and ornament the structure, barge boards may be put on the ends, and their addition will much improve and beautify the greenhouse, while the extra labour involved is but little. A simple design for barge boards is given at Fig. 19, while Figs. 20 and 21 are of a more ornamental nature. There are many minor alterations in the details of construction that may be made to suit particular requirements, or as the fancy of the builder may dictate; as, for instance, instead of lining the lower part of the house with wood, bricks may be used to fill in with, in which case the sole and belt rails would require to be the width of the bricks used, and would also be made in the roof if desired, and hinged at the upper end, but this is not so desirable, as there is a certain amount of difficulty in keeping roof openings water-tight, and, if ventilation is wanted high up, the end fanlights will serve every useful purpose.

Roof ventilation can be had, however, in a very simple manner, as will be seen on referring to Fig. 25, which gives a section of the roof, in which an opening board running the entire length of the roof is shown. For convenience in lifting, this board may be sawn across in the middle, and should have cross ends grooved on to prevent warping. In this style of construction it will be seen that the roof sashes do not come up to the ridge board (the stiles had better be kept the full length to afford a support for the ends of the ventilating board); they are kept about 5 in. short, and rest upon rafters, of which there should be three on each side of the house, one under the joint of the sashes, the other two at equal distances from it and the ends of the structure.

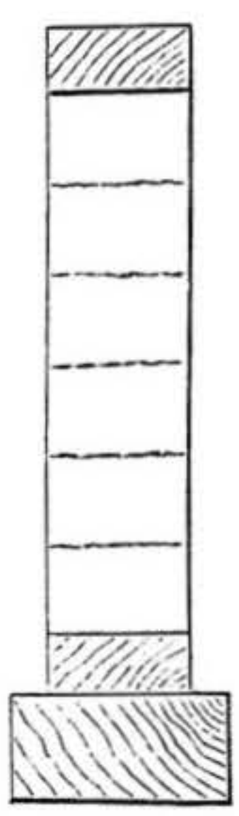


Fig. 22.

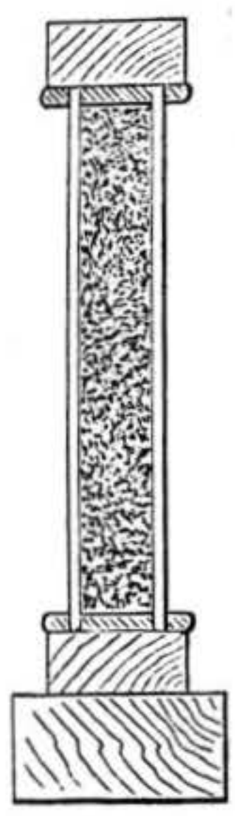
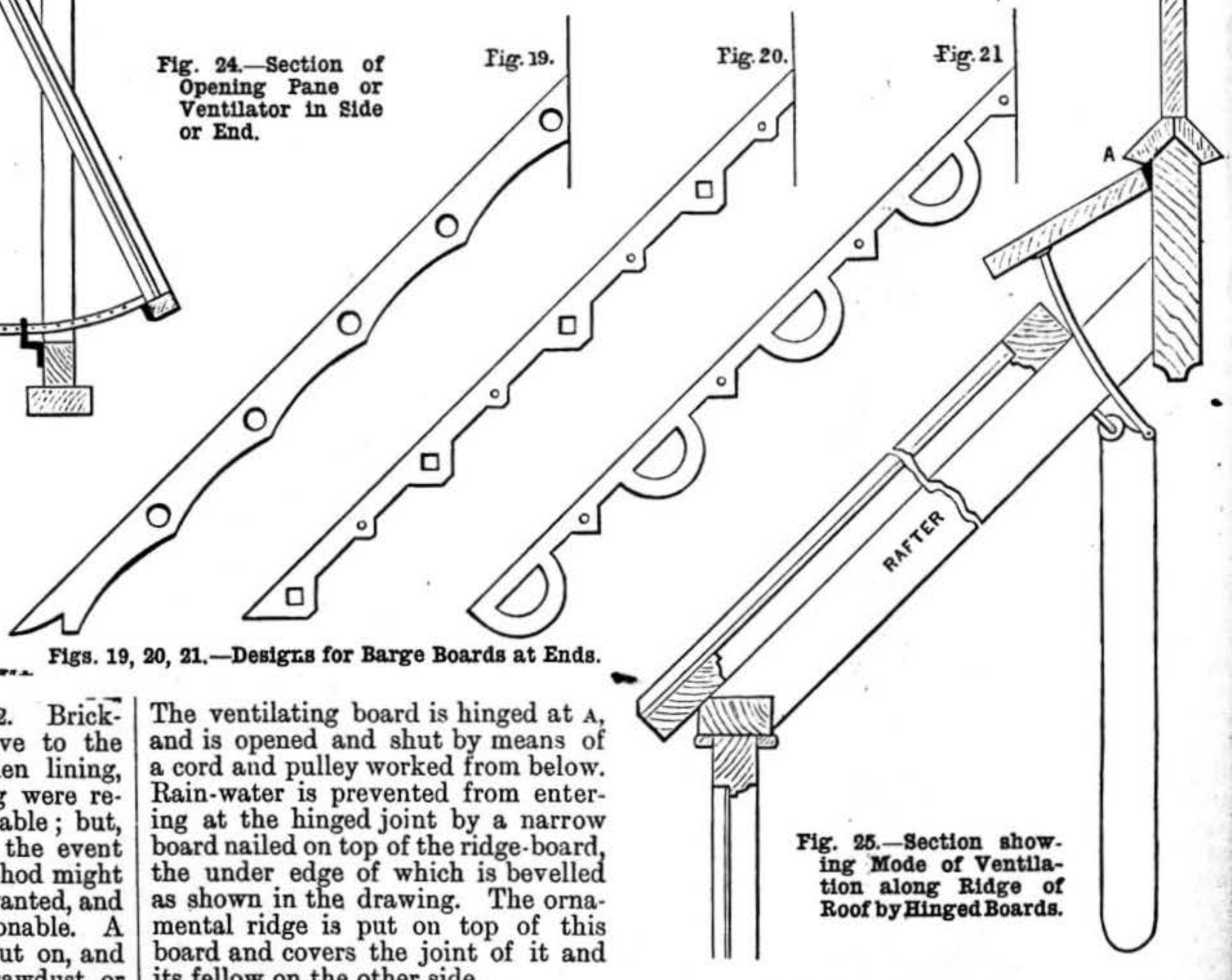


Fig. 23.

Fig. 22.—Alternative Mode of Filling in between Sill and Sashes with Brickwork.

Fig. 23.—Alternative Method of Using Double Boarding and Filling with Sawdust.

Fig. 24.—Section of Opening Pane or Ventilator in Side or End.



Figs. 19, 20, 21.—Designs for Barge Boards at Ends.

appear in section as in Fig. 22. Brickwork is certainly more conducive to the preservation of heat than wooden lining, and, in case that artificial heating were resorted to, would be very serviceable; but, then, bricks are not so handy in the event of a removal, so that another method might be had recourse to if heat were wanted, and the use of brickwork was objectionable. A double lining of wood could be put on, and the space between filled in with sawdust, or other material, in which case the details would be as in Fig. 23; both the inner and outer lining taking the form of panels, and being secured by screws only.

As to the opening of the fanlights in the ends, there are some florists who object to that mode of ventilation, and who prefer to have the opening panes at the sides of the house. In this case the alteration in structure is obvious; fix the square sashes in the ends, and make a pane in each of the side sashes to open. For this purpose two thicker sash bars must be put in to carry the opening pane (say 1½ in. thick), which will be hung on pivots in the style of Fig. 24; keep the pivots nearer the top than the bottom, and put on an iron strap with holes in it to catch on a pin, as shown, so that the window can be opened and kept in position as wanted. Opening panes can

The ventilating board is hinged at A, and is opened and shut by means of a cord and pulley worked from below. Rain-water is prevented from entering at the hinged joint by a narrow board nailed on top of the ridge-board, the under edge of which is bevelled as shown in the drawing. The ornamental ridge is put on top of this board and covers the joint of it and its fellow on the other side.

The wooden sill on which the greenhouse rests can have the earth loosely banked up against it to hide its roughness, while the part at the door can either form a step upwards from the garden level, or the approach to it may be gradually raised so as to do away with the step entirely. There are many little details that will suggest themselves to any one who constructs a house of this kind, and the imperfections of the one described, though many, may be smoothed away. My aim has been to fix my attention more on the fact that the house must be removable at will, and so out of the power of the landlord to seize as a fixture, and at the same time be tolerably easy of construction, rather than that it should be perfect in either design or proportion. This aim I think I have accomplished, as every part can be unscrewed and taken separate, the sill lifted and knocked asunder, and the whole packed on a waggon and carried off, the garden ground remaining without so much as a stakehole in it, excepting, always, the drain pool two feet below the surface.

Two minor details I might draw attention to: the outer corners of the corner posts would be much improved by stop chamfering, or rounding; and it would also be advisable to bevel off the outer top edges of the top rails of the side framing for, say, 1 in., so as to allow the roof sashes to have a better hold. These things are not absolutely essential, but are desirable.

There are many houses in London, and other places, that have anterooms, kitchens, etc., projecting in the rear, and having flat roofs, often covered with asphalt or cement. On such a roof as this the greenhouse could be erected, and entrance to it be had either from a window or by means of a trap stair, or even by a staircase or steps placed without if there were no means of access from within. In such a position the possession of it would be doubly desirable to the town resident who often has to content himself with a paved backyard and a few pots of flowers, as by its aid he would be able to cultivate choice plants and enjoy his gardening hobby to a much greater extent than he could hope for without the aid of some such easily erected structure.

The amusement to be obtained from a small greenhouse, to say nothing of the profit, is considerable, and no man who can manage to put one up, however poor in general appearance it may be, should be without one. In a house with a good southern exposure, cucumbers may be grown readily, and the vines trained along the sash bars, or better, on wires a little below the sash bars or rafters. Tomatoes may also be grown to please the eye, first of all with the rich hue, deep scarlet or amber, as the case may be, of the clustering fruit, and then the palate, either cooked or in the form of salad.

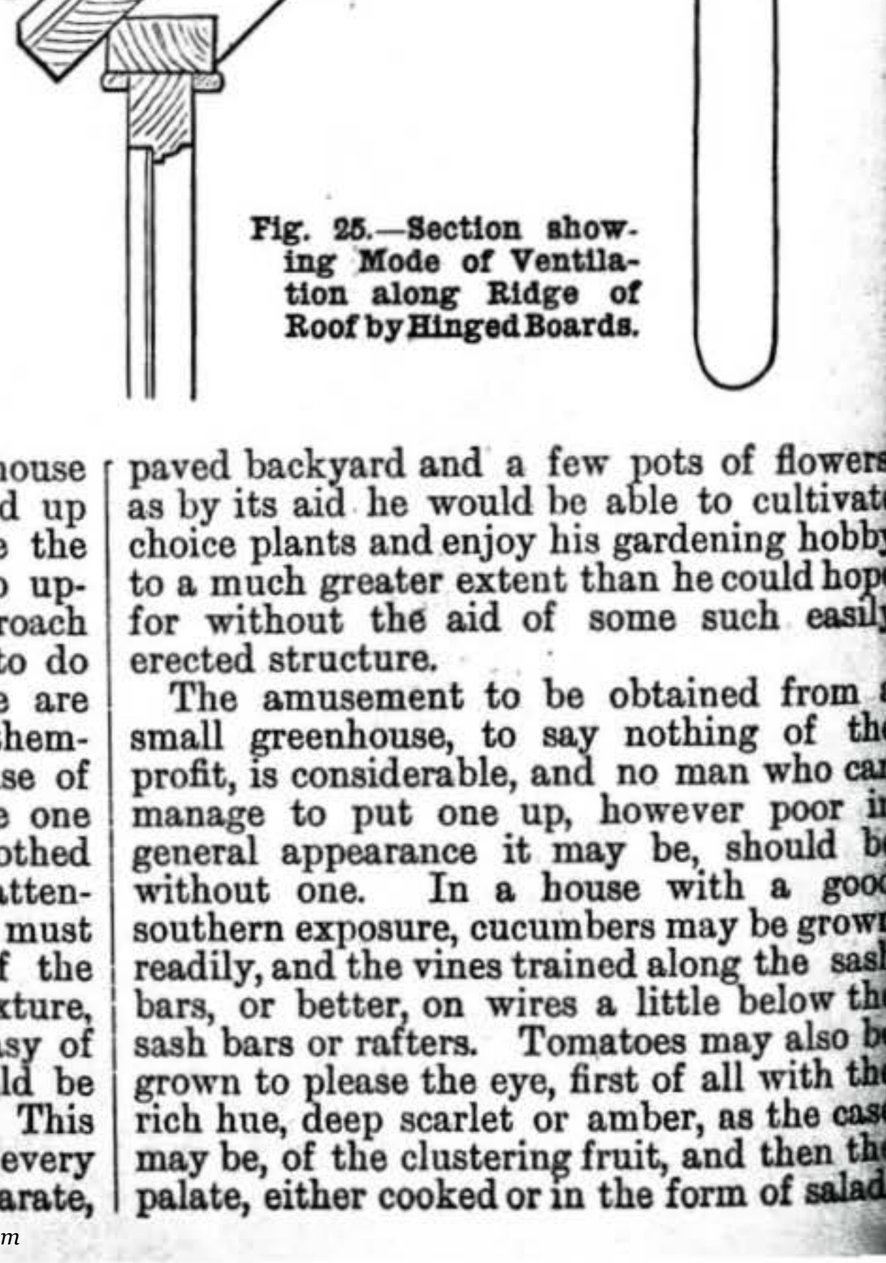


Fig. 25.—Section showing Mode of Ventilation along Ridge of Roof by Hinged Boards.

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WROUGHT IRON AND STEEL GIRDER WORK.

BY FRANCIS CAMPIN, C.E.

(*Continued from page* 187.)

SMITHING, PLANING, PUNCHING, DRILLING.

IN some classes of girder work there is a great deal of smithing to be done in cranking angle and T irons, and joggling their

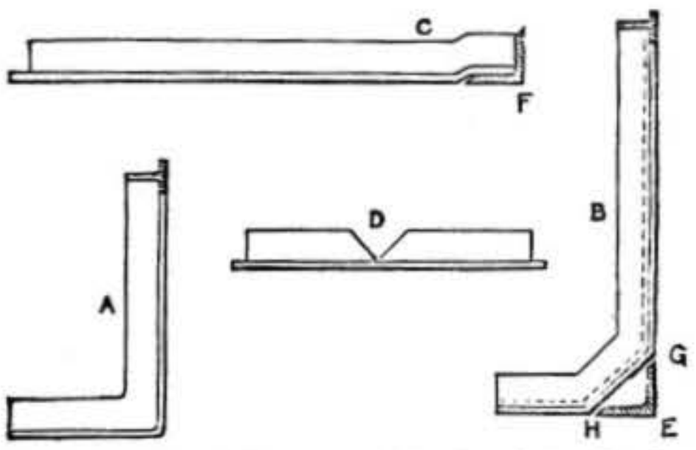

Fig. 6.—Principal Forms of Ends of Angle Bars, T Bars, etc.

ends, and there are two principal methods in use for effecting this : drawing the bars over a block by the hammer, and forming them in dies actuated by hydraulic pressure. In both cases the material is worked at a red heat, the temperature being lower for steel than for iron. In Fig. 6 are shown the principal forms to which the ends of T and angle bars are shaped ; A shows one bent at right angles, frequently used in connecting cross girders to the webs of main girders ; B is a cranked end used for stiffeners, which are riveted to both the web and flanges of plate girders ; the cranking allows them to clear the longitudinal angle irons of the main girders. Such an angle iron is shown in section at E in the position it would occupy in the main girder. At C is an end of a bar joggled to pass on to the limb of an angle iron, on the same plate as that to which it is riveted itself. In some cases the bar ends have to be skewed, or bent sideways as well as vertically, but such forms should always be avoided where possible. To make the square bend, A, it is necessary to cut out a V-shaped piece as shown at D, then the bar is bent and the cut limb welded together again. A weld is always objectionable, doubts as to its soundness being very apt to arise, but in this case it cannot be avoided.

The whole difficulty in welding is in keeping the surfaces to be joined clear of scale and other extraneous matter, which might get closed up in the weld and so cause a flaw, which, being hidden, would escape detection. By the recently introduced methods of welding by the heat derived from gas, a greater degree of certainty as to the soundness of the welds produced should be created, and more satisfactory results still may accrue from electrical welding, if it proves easy of manipulation in the every-day routine of a workshop. In such operations as that of welding, the results of experiments specially made scarcely form any criterion of practical utility, especially where the piece-work system is in force. In the electrical welding, moreover, there must be an element of danger, from the magnitude of the currents necessary to produce a welding heat.

In making the square bend, A, there should be practically no alteration in the length of the bar, but in drawing the end over a block to form the cranked end, B, there will occur some lengthening, more or less considerable, according to the temperature at which it is worked, and the aptitude of the smith working it. In order to save waste, the bar should be cut off to such a length as will, when bent, be of the required dimensions. I have found in average work that it is about right to measure the drawing or template just clear of the root of the angle or T iron, as shown by the dotted line on bar, B. If the iron is very deep on the web, it may become necessary to cut and weld the bar even in making the crank end, B. In such cases it is better, instead of making the two distinct bends, to curve the bar uniformly from G to H ; in this way none of the metal is lost ; it goes in thickening the web of the T iron. In the joggled end, C, there is no element of difficulty; the bar requires slightly upsetting and then hammering down to shape, and a little extra length must be allowed in cutting off the bar for the joggle. The ends of the bars will require to be trimmed off square after they are worked, and for this about a quarter of an inch at each end is sufficient.

A much more satisfactory job is made by using hydraulic pressure to make these bends ; then the bars are not lengthened, and therefore not thinned, but the slight excess of metal goes to thicken the web and make the bar stiffer at the bend, and, therefore, stronger for its particular duty in maintaining unaltered the angles of the parts of

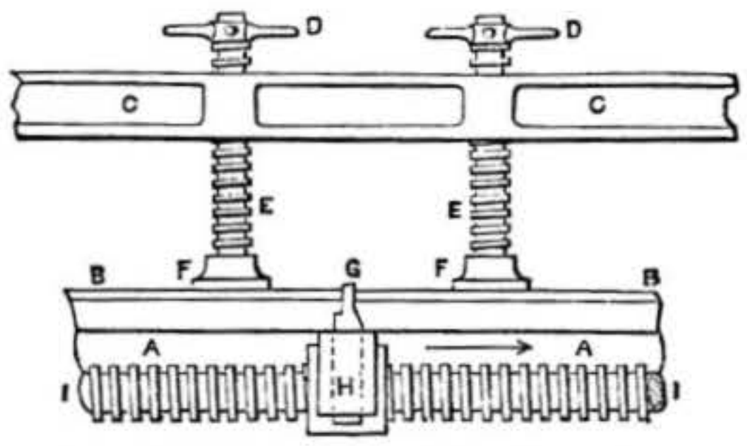

Fig. 7.—Front View of Plate Edge Planing Machine.

the girder to which it is riveted with each other. The fact that this thickening must take place, must be borne in mind during the preparation of the dies, and the requisite room allowed for it, otherwise they will not work. Another considerable advantage that is secured by the hydraulic method of making these knees, is that they are all turned out exactly alike—a result not to be hoped for with hand labour—and, therefore, the uniformity of the work is ensured, and the true bearing of all the stiffeners will materially aid in securing the rigidity of the structure. It may here be mentioned that in hand-bent bars the angle irons will be more troublesome than the tees, on account of their always tending to open out at the bend.

We must now follow our work to the machine shop, where the various parts are to be brought to their correct sizes and made to fit properly together. The planing of the plate edges and ends will first receive our attention. The plate-edge planing machine differs very materially from the planing machines of the engine shops, inasmuch as in the latter the bed of the machine—on which the work is fixed—moves while the cutting tool is at rest, but in the former the reverse is the case. Fig. 7 is a front view of a plate-edge planing machine, shown broken off, as they are made of considerable lengths in order to allow the edges of long plates to be planed throughout without having to shift and refix them on the bed of the machine, an operation of the greatest delicacy to ensure a straight edge throughout the length of the plate. A A is the bed of the machine upon which the plate to be planed, B B, is firmly held down by the heads, F, F, of the screws, E, E. These screws are adjusted by the cross handles, D, D, and work in threads cut in the longitudinal beam, C C. G is the cutting tool carried in the tool box, H, which is driven by a strong square-threaded screw, I I. The machine is fitted with an automatic tumbler to reverse the motion of the screw at the termination of a cut.

The plates having been planed on both edges, a number, of the same width, may be laid together and fixed on the end planing machine, and their ends all planed at one operation by a milling tool, which is essentially a revolving cutter working at right angles to the length of the machine bed. The revolving cutters as formerly made were far from being perfect, but during the past ten years very great advances have been made in the appurtenances of milling machines, and very good work is now turned out by them. In recent years, also, emery wheels have come into use, more especially on the continent, for finishing off certain parts such as the ends of cross braces and other parts that require to be accurately fitting at the joints, but I do not much incline towards their use.

The plates having been planed, or otherwise shaped, the making of the rivet holes comes next. If they are plain punched they will probably require some rymering, but with this I shall deal subsequently, merely pausing here to point out the disadvantage of using rymers under these circumstances. It is very important to get a clean hole so that the bearing of the rivet may be uniform, and to obtain this a tool with an accurate cutting edge must be employed, and the edge of an ordinary rymer is not a cutting but a scraping edge, the angle of its cutting edge being not less than 90°. The use of such a tool must tend to bulge the plate.

When the rivet holes are drilled, as in the best class of work, multiple drilling machines are used, and several plates may be drilled together, thus ensuring the exact coincidence of the rivet holes with one another, and abolishing the necessity of

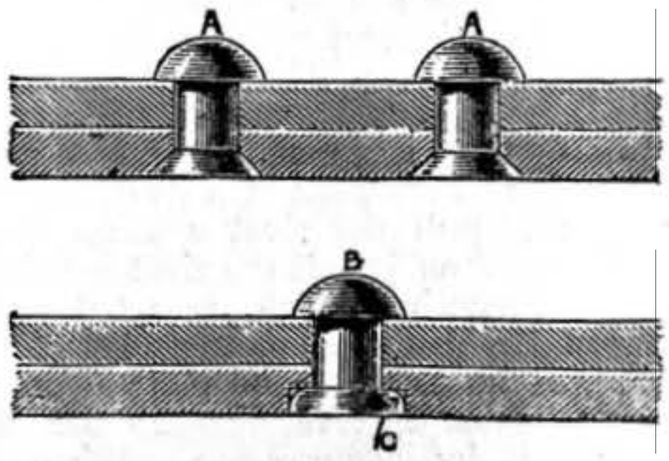

Fig. 8.—Examples of Countersinks for Rivets.

rymering out the holes afterwards ; the only treatment the drilled holes require is the removal of the sharp rises around them, which might tend to start a crack under the rivet head during the cooling and contraction of the rivet.

The drills used should be carefully made with true cutting edges, the preference being given to what are known as twist drills, which, besides having true cutting edges, run very steadily, and, therefore, do good work, the chatter which occurs with scraping drills being avoided. I have referred to the difference in widths between

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the top and bottom of the web plates, caused by the practice of cambering girders; this will necessarily cause a difference of pitch between the top and bottom rows of rivets, unless the whole difference is taken up in the end pitches of each plate, which is certainly not so convenient as running a uniform pitch the whole length of the girder. The having to break pitch in certain places on the longitudinal angle irons has a tendency to lead to mistakes, and in any case it precludes the changing place of angle irons if it should be desired to alter the position of the joints for convenience of carriage or any other reason. Of course I know that all these points of detail should be definitely settled before the work is sent into the yard, but I also know from experience that it not unfrequently happens that a great many alterations are made during the progress of construction, and it is therefore advisable to be as far as possible prepared for any emergency that may arise. In the example taken, it was found that to give the requisite camber, the plates which were four feet wide at the bottom had a top width of 4 ft. $\frac{1}{16}$ in. At 4 in. pitch the number of rivets in the bottom edge would be twelve, and the same number should be put in the top edge, the pitch being found by taking a line 4 ft. $\frac{1}{16}$ in. and dividing it up into twelve parts with the compasses. When riveted girders rest upon plane bearings, it is necessary to sink the heads of the rivets in the plate on the side in contact with the bearings; therefore, in such positions, the rivet holes have to be countersunk as shown at A, in section, Fig. 8. The countersinks should be cleanly made with drills or rosebits, and where the thickness of the plate will allow, it should not be less in depth than one-third the diameter of the rivet, but it should not exceed one-half the thickness of the plate. Could the rivets be properly closed, a square sink, as shown at B, would be preferable, as it would give the rivet head a better hold upon the plates, but the sharp corner, C, running round the rivet would not get filled in. I am inclined to think that, at the hands of designers, the rivets do not receive the amount of consideration to which they are entitled. The whole safety of a structure depends upon its joints, and the most careful and elaborate calculations of main sections will be wasted if not followed up by correctly proportioning and placing the rivets. The strains to which rivets are subjected depend upon their positions; thus, if a load is held by a member hanging on the head of a rivet, the tendency is to pull the rivet asunder, or to strip the head off it. If the rivet is holding two plates together which are acted on by forces in the direction of their length, the effort will be to slide one plate upon the other and shear the rivet through the body or crush it by compression. When the rivet is intended to resist the first kind of strain, it is evident the head should be of sufficient thickness to afford as much strength against stripping off as its body does to tearing across. The stripping off of the head will evidently be a shearing strain, and the surface acted upon will be the circumference of the rivet multiplied by the thickness of the head. The surface resisting tearing is the cross sectional area of the rivet. The working strengths are for iron in shearing, 4 tons per square inch of sectional area; and for tensile strain, 5 tons. The cross sectional area is equal to the square of the diameter multiplied by 11 and divided by 14; and the stripping area is equal to the thickness of head multiplied by the diameter of the rivet and by 22 and divided by 7. These two sums being equal would give equal areas of resistance, in which case the thickness of the head would be one quarter of the diameter of the rivet; but the resistance to stripping is only four-fifths of that to tension, so one-fourth must be added to the stripping area, thus making the least thickness of the head equal to five-sixteenths the diameter of the rivet, and it is better practice to make it at least three-eighths the diameter. Now, in regard to the second kind of joint, the resistance to compression is the same as that to shearing, so the bearing area of the rivet in its hole should be equal to its cross sectional area. The bearing area measured square to the line of strain will be the diameter of the rivet multiplied by the thickness of the plate, and to this must be equal the square of the diameter multiplied by 11 and divided by 14, when the diameter of the rivet will be equal to the thickness of the plate multiplied by 14 and divided by 11.

THE PREPARATION OF PLATING SOLUTIONS.

BY F. W. MASON, CONSULTING ELECTRICIAN AND CHEMIST.

CLASSIFICATION—GOLD SOLUTION—SILVER SOLUTION—PLATINUM PLATING—COPPER SOLUTION—LEAD SOLUTION—NICKEL SOLUTION—BRASS SOLUTION.

IN the preparation of these, as most platers are aware, too much care cannot be given. Plating solutions may be roughly divided into two classes:—First, those of the rare or precious metals, as gold, silver, and platinum; second, those of the coarse or common metals, as copper, zinc, etc. Before proceeding further, it may not be out of place to state that all figures employed throughout this article are the results of practical experience, and not the mere figures attained by a few experiments. I will, first of all, give the preparation of solutions of the rare metals, as these are of the most consequence, and likewise the most frequent in use.

Gold Solution.—First in order let us consider the gold (*aurum*) solution, which is best made up to the strength of 8 dwt. to the gallon. To make it, proceed as follows: Take 8 dwt. of fine gold and put it in a porcelain dish of about 40 oz. capacity—an enamelled saucepan will do if this is not attainable—then pour upon this, gently, about 4 oz. of aqua regia (which is a mixture of hydrochloric and nitric acid, used in the proportion of two of the former to one of the latter), then gently heat the vessel containing the gold and aqua regia over a Bunsen burner—this to accelerate the chemical action. When the gold is dissolved, pour the solution of chloride of gold into another similar vessel and evaporate the acid off; a red mass will be the attainment thereby. If too much heat is used the gold will be reduced to the metallic state; if this should be the case, add a little more aqua regia to re-dissolve, and then re-evaporate. When the acid has been driven off, add to the resultant chloride of gold about one pint of distilled water, or failing this, use water that has been vigorously boiled and filtered. If, when the chloride of gold is added to the water, there exists a white precipitate, the chloride of gold solution should be carefully poured off it, and this precipitate is chloride of silver; it should never, on any account, be allowed to get into the gilding solution. Then to the solution of chloride of gold, a strong solution of cyanide of potassium should be added (this need not be of any specific strength); the result of this addition of cyanide of potassium to the chloride of gold is a brown precipitate of cyanide of gold. The solution of cyanide should be carefully added, so that a drop at last should have no effect upon the clear solution. If you add too much cyanide, you will re-dissolve the cyanide of gold. This cyanide of gold should be allowed to stand for about fifteen minutes, and then the clear liquor poured off; the precipitate should then be washed two or three times with distilled water. This is done as follows: A quantity of distilled water is poured upon the precipitate; this is then allowed to settle and the water run off; this is done two or three times, as before stated. When the cyanide of gold is sufficiently washed, a solution of strong cyanide of potassium is added to dissolve it. When the gold cyanide is dissolved, a quantity of the solution of cyanide of potassium is added to it to form free cyanide. This is essential in the working of the solution; then a sufficient quantity of distilled water is added to make up to one gallon. This solution must be worked with a pure gold anode, and a battery power of two Bunsens, holding about a pint and a half each. If the solution works a bit slowly, a little fresh cyanide should be added, but you must be careful not to add too much, or the work will have a foxy colour. The solution must also be worked at a temperature of 125° Fahr. to 135° Fahr., with a solution same strength as above, and worked at a temperature of 132° Fahr., and two quart Bunsens the colour of the work has been first-class, far better than with other heats and strengths of solutions and currents.

Silver Solution.—This is prepared somewhat similar to the gold solution. Take 1 oz. of fine silver, and add to it about 3 oz. of nitric acid (this should be in a porcelain dish); stand this in a warm place; the silver is soon dissolved. As soon as the red fumes given off during the chemical process have ceased the silver is dissolved; the acid is then evaporated off, and the nitrate of silver treated exactly as the chloride of gold was treated. The solution is made up to one gallon, to be worked with a silver anode and two Bunsen cells, the same size as those used for the gilding. If the work is wanted to be of a bright colour, it can be obtained by the use of a little bisulphuret of carbon added to the solution; the way it should be added is as follows:—Take about half a Winchester of the silver solution and add to it 3½ F. oz. of bisulphuret of carbon; cork the Winchester and well shake it, and allow it to stand for a quarter of an hour, then shake again and allow it to stand. This should be very cautiously used; it should be added to the plating solution at the rate of 2 oz. per gallon of plating solution. This gives a bright, lustrous appearance to the work.

Platinum Plating.—This is generally done by means of a solution of bichloride of platinum ($PtCl_2$). Perchloride is the same as bichloride. This bichloride is prepared by dissolving the metallic platinum in aqua regia (equal mixture of nitric and hydrochloric acids). I myself prefer to use two parts of hydrochloric to one part of nitric acid. When the platinum is dissolved the reddish solution is evaporated down to a syrup, then re-dissolved in hydrochloric acid, and evaporated down to a syrup again. This is then cooled; it then solidifies to a solid mass. Care should be taken that the

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solution is not overheated in evaporating it down; as, if this is done, it will be found that the plating solution will be almost worthless. I myself also prefer (in the making of the bichloride) to use old platinum crucible lids in preference to new, or platinum wire. This old platinum, before being dissolved, should be boiled for about ten minutes in nitric acid, and afterwards dipped in a strong hot solution of caustic potash, washed, dipped again in nitric acid, and afterwards rewashed in distilled water; the platinum is then dissolved. If the platinum does not dissolve pretty quickly the application of a little heat will soon hasten it; I generally find, myself, that the solution requires a little heat. For the plating process I prefer to use a solution of the double salt of chloride of sodium and platinum, prepared by dissolving 268·4 parts of bichloride of platinum in distilled water containing 58·5 parts of chloride of sodium (common salt); to this add 55·96 parts of caustic potash. The solution should be made up so that it contains 400 grains of platinum in two quarts of water. Throughout these experiments distilled water was used; failing to obtain this my readers should use water that has been boiled for awhile and then filtered.

The following are the figures I employ for my bath:—Bichloride of platinum, 400 grains; chloride of sodium (common salt), 87·183 grains; caustic potash, 83·420 grains; distilled water, 2 quarts. The decimals can be rejected, and the whole numbers taken without any serious inconvenience. With this strength of solution I prefer to use a small anode and a weak current—about two Bunsens are the best. This current will, I think, be a little too strong; if so it should be regulated to the proper intensity by means of the ordinary plater's resistance board; the current I employ is 2·22 volts. This gives a very fair reguline deposit, far better than with any other strength of battery current employed; the article does not require much moving about in the bath, nor does it require (except in some cases) a very high temperature; between 65° and 70° Fahr. is very good. But a few words regarding the treatment of the articles themselves that are to be platinised. I cannot lay too much stress on having them scrupulously clean; in fact, experience proves to me that the cleaner they are the better the deposit takes place. For my method I use the ordinary acid dips, and then boil them in a strong solution of caustic potash, and then well wash them in distilled water, and then immerse them immediately in the bath. The only drawback to platinum plating is its troublesome working, which can be overcome by using the proportions named.

Having described the preparation of the rare solutions of gold, silver, and platinum, I will now proceed with the common metals, copper, lead, nickel, and brass.

Copper Solution.—First, we will take that of copper, as this is the preparation most frequently used. Take of copper sulphate 1 lb., dissolve this in boiling water, add 9 oz. of strong sulphuric acid, and add water to make up to one gallon; work with two Bunsens and large copper anode. Watt, in his book, prefers to use a little arsenious acid added to this solution, but I do not think that there is any absolute need for it.

Lead Solution.—One pound of acetate of lead in one gallon of water, and adding cyanide of potassium to precipitate the lead as lead cyanide, and then adding enough cyanide to re-dissolve this, and also to form free cyanide. Work with a pure lead anode and two Bunsens; but this has hardly ever been a commercial success, it has been mostly tried as an experiment.

Nickel Solution.—This is usually made of the double salt of nickel and ammonia. This should be made up to the strength of 15 oz. of the double salt to the gallon. Prepare the salt as follows (I believe this process was first invented by Mr. Unwin):—Take of nickel 14 oz., dissolve it in three parts of strong nitric acid and one part of strong sulphuric acid, and four parts water. When dissolved, which is known by the fumes (caused by chemical action) ceasing, add a little hot water and filter; the deep green liquid obtained is a strong solution of nickel sulphate. Then make up a strong solution of ammonium sulphate. This is done by dissolving 4 lb. of the salt in a gallon of water, then mix about half of this with the sulphate of nickel and make up with water to one gallon; work with a pure nickel anode and three Bunsens.

Brass Solution.—This is best done by the following solution:—Acetate of copper, 2 oz.; potash, 2 lb.; sulphate of zinc, 5 oz.; liquid ammonia, 1½ pint; cyanide of potassium, 4 oz. Dissolve the acetate of copper in a quart and a half of water, add half the ammonia, then dissolve the sulphate of zinc in two quarts of water at 190° Fahr. When the zinc is dissolved add the other half of the ammonia to it. This should be well stirred for a few minutes, then dissolve the potash in two quarts of water, and, lastly, dissolve the cyanide of potassium in another quart of water. Then add the solution of copper to the zinc solution, then the cyanide, and then the potash. Stir well, and allow solution to stand for two hours, then make up solution to 3½ gallons. Work with a milled brass anode (which should be well cleaned before immersion) and three Bunsen cells. A little ammonia and cyanide may be added when the solution works slowly. Watt, in his book, prefers to use a small amount of arsenious acid to the solution. If added, it should be at the rate of ¾ oz. to six gallons.

As before stated, these solutions must be prepared with care, cleanliness in the manipulation of the solutions, both in making and working, being strictly adhered to. If this is seen to, I have not the least doubt that success will follow, as all solutions given have been tested by long practical experience. Any information or advice any one may require, I shall be pleased to give.

SOME RATIONAL BOOKSHELVES.

WITH A FEW COMMON-SENSE HINTS ABOUT BOOKSHELVES GENERALLY.

BY MARK MALLETT.

MODE OF CONSTRUCTION—CAPACITY OF BOOKCASE—DIMENSIONS—ARRANGEMENT FOR VARIOUS SIZES OF BOOKS—SIDEBOARD IN CENTRE—MIRRORS AT BACK—CORNICE, FRIEZE, ETC.—MATERIAL MOST SUITABLE—EBONISING—PROTECTION FROM DUST—SHELVES, FIXED AND MOVABLE—"BRIDGE" FOR SHELVES—PROTECTION OF EDGES OF BOOKS—PRECAUTIONS AGAINST DAMP.

THE construction of bookshelves is a matter on which a little more common sense might often be brought to bear with advantage. Notwithstanding that books vary as much in breadth as in height, we see but little allowance made for that fact, and, as a rule, the shelves occupied by small books project into our rooms and take up space in a way that is quite needless; besides which the uniform projection from the wall of an ordinary bookcase of any considerable size renders it a heavy and disagreeable piece of furniture to the eye. The plan adopted by the writer, and which he now has to submit, is based on the rational old principle of making a big hole for the cat and a little hole for the kitten—a wide projection, that is, for the great folios, and a narrow projection for the octavos and all the smaller fry of volumes; he claims, also, some other advantages for his shelves, of which mention will be made in due course.

The bookcase shown in elevation in Fig. 1 is intended to accommodate some 700 volumes. An elevation of it has been given rather than a perspective view, because the former, being to scale, is available as a working drawing; yet it must be admitted that it does not do justice to the piece of furniture, artistically considered. Thus drawn it looks square and flat, which the thing itself does not look. In the actual thing the wings projecting in the upper part disguise the fact that the top is bounded by a straight line; the ranges of books are agreeably broken by the bright looking-glass in the middle; whilst the broad shelf beneath it, and the projecting centre of the lower part, convey anything but an idea of flatness.

Fig. 2 is a vertical section on the line, A B, of the above elevation, and Fig. 3 a second section through the centre of the shelves on the line, C D. Fig. 4 gives the central shelf (E, Fig. 1) as it might be seen on its lower side, with sections of the uprights which support the lower shelves; and Fig. 5 gives the upper side of this shelf, with the uprights of the upper portion. These five illustrations are on a scale of ¾ in. to the foot; the set of shelves being 9 ft. long by 6 ft. 4 in. high—that is, 3 ft. 6 in. to top of the wide central shelf, and 2 ft. 10 in. above. That damp—the old enemy who "foxes" books—may be the better avoided, the lowest shelf is kept 3 in. above the floor line.

In a collection of books the average numbers of the different sizes can be pretty accurately guessed, and the spaces for them are arranged accordingly. In the lower portion the central compartment is for *folios*. It is but narrow—only a foot in width—and has but two shelves, for not many folios fall to the lot of any ordinary reader of these days. That it should be narrow there is a second reason: folios are of great weight, and the bearings of a shelf that carries them should not be far apart. This compartment has a depth of 13 in. The lower shelf is some 18 in. high — high enough, that is, to hold *Blackie's Imperial Atlas*, or bound volumes of the *Graphic* or *Illustrated London News*. Ordinary human beings cannot be supposed to have bigger books; if they have they must provide special houses for them. The second shelf is 16 in. high, and above is a recess, 7 in. in height, intended as a receptacle for newspapers, etc.

On each side of this are compartments 15 in. wide, and having a depth of 11 in., which is ample for *quartos*. The six shelves in these are from 12¾ in. to 14 in. high.

But the great majority of our modern books are *octavos*, and to them (including smaller books) all the remaining space is apportioned. In the lower portion the compartments are 8 in. deep for the larger books of this class, while in the upper part they are only 6 in. deep; but that suffices for the lesser octavos, and for still smaller sizes. These compartments are 30 in. wide,

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and the sixteen shelves range from 10½ in. to 6 in. high; the wings which hold them interfere but little with the space in the room, since at bottom they project but 8½ in. from the wall, and in the upper part no more than 6½ in.

Figs. 4 and 5, as well as affording horizontal sections of the lower and upper portions of the case, illustrate the peculiar shape of the central shelf (E, Fig. 1), which rests on the tops of the lower uprights. As it overhangs the uprights by an inch at each end, it is 9 ft. 2 in. long, and its breadth at the middle is 16 in., a width which allows it to serve as a kind of sideboard, which may be turned to useful or to ornamental purposes, or to both. Had the writer wished to show his design in an attractive rather than in a practical form, he would have represented some æsthetic pieces of crockery as ranged on this shelf and reflected in the glass behind them, but he leaves this to the imagination of his readers.

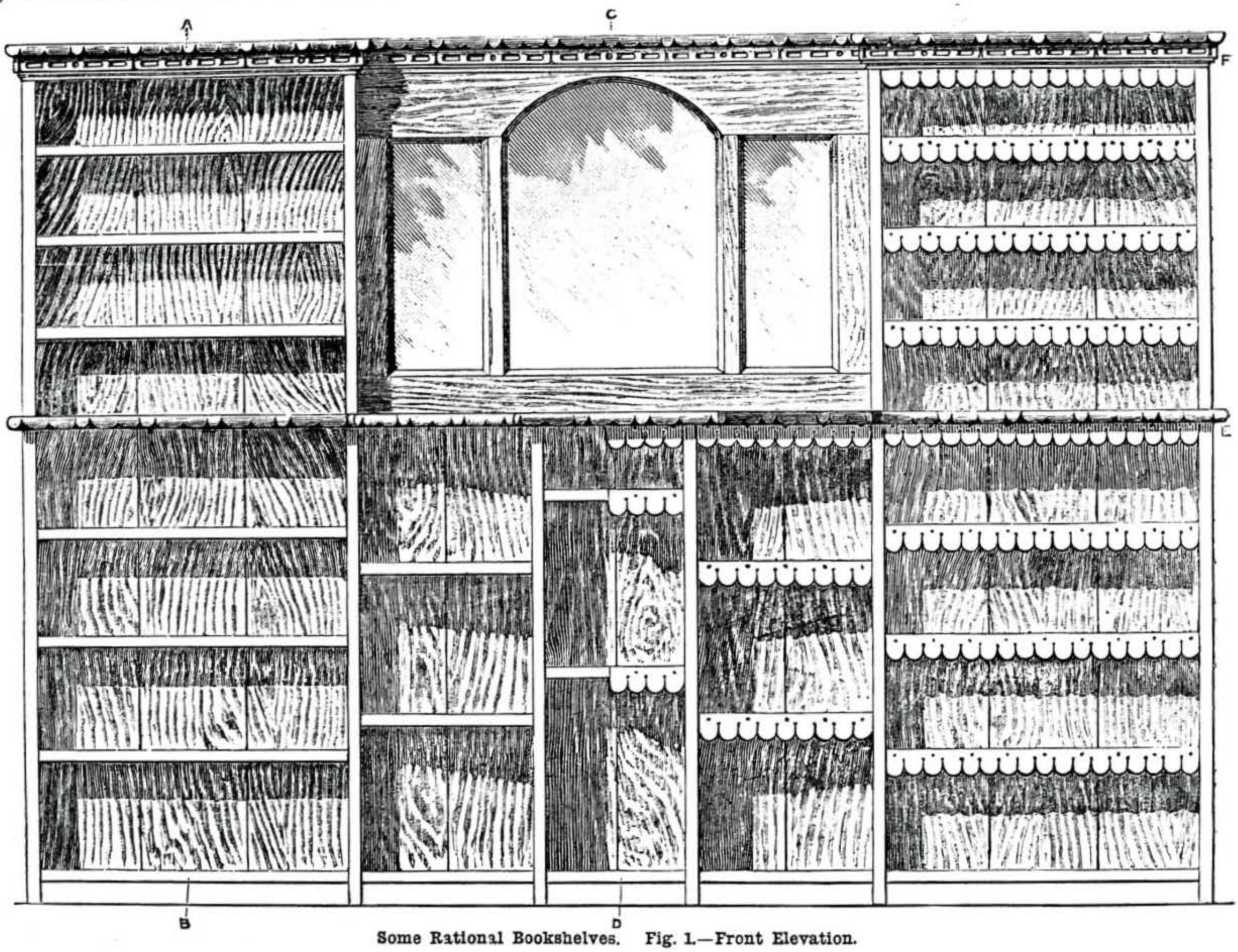
In a set of shelves built by the writer on this model, an old Vauxhall glass, with its characteristic gold frame, has been used. But all who may wish to work on the same lines may not have such a glass to their hands, and, therefore, in the present drawings three panels of ordinary looking-glass have been shown, as introduced. They are fixed in a very simple manner. The whole of the shelves are backed with ½-in. matchboarding; this is continued over the space occupied by the glass, and to it the two horizontal and four vertical strips of ¾-in. wood, which form a frame to the panels, are screwed, the glass itself being held in place by a narrow strip of gold moulding fastened with needle points.

The cornice (F, Fig. 1), which, of course, runs along the ends of the wings as well as along the whole front, is, as shown in the elevation, relieved by a little simple gouge work, which is so simple that it can scarcely need a separate diagram for any one who would be likely to work it out. But most persons will probably consider this decoration, as well as the enrichment along the front edge of the central shelf, superfluous; and in the full-size section of this cornice (Fig. 6) the frieze, G, is left plain, and merely an ordinary moulded beading, H, is placed upon it, whilst I is a gilt beading. This and the other gold beadings are introduced on the supposition that the woodwork generally is ebonised, in which case a little gold will have an excellent effect, whilst it adds but a few pence to the cost.

With a view to ebonising, inch pine is recommended for the uprights, and ¾-in. pine for the shelves, etc.; the whole is backed, as has been already mentioned, with ½-in. matchboarding. The top and bottom portions are made separately for convenience of removal, etc., the former being kept in place on the latter by four dowels driven into the central shelf, which fit into holes in the four uprights of the top. It is better to fit the work together with screws before ebonising the wood; then to take it to pieces, to brush it over with a strong, hot decoction of logwood, and afterwards with iron dissolved in vinegar. The boards can be kept from warping by letting them dry under sufficient weights. They have to be polished with beeswax and turpentine melted together; little wax and plenty of good hard rubbing is the secret of getting a good polish.

For the protection of the tops of the books from dust nothing looks so well as the stamped and gilded strips of leather, sold for the purpose, nailed along the front edges of the shelves. These are, however, costly, and one half of the elevation, Fig. 1, is shown as finished with a cheaper substitute in the shape of American leather cloth. With ebonised wood cloth of a dark green colour looks best, and the strips should be deeply cut between the scollops, as in Fig. 7, to allow of the easy taking out and replacement of books. The strips are fixed to the shelves with brass nails. The scollops may be quickly cut by laying the cloth on a lump of lead and cutting with a gouge of proper size.

The shelves in this design are not made adjustable, being screwed down to small strips, which, in their turn, are screwed across the uprights. So far as the experience of the writer goes, unless in a very solidly-built bookcase, adjustable shelves involve more loss in the shape of strength than gain in the shape of convenience. As has been already observed, the proportion of volumes of different sizes in a collection can be pretty accurately calculated, and no great difficulty will be found in providing sufficient accommodation for those of each size. Any arrangement



Some Rational Bookshelves. Fig. 1.—Front Elevation.

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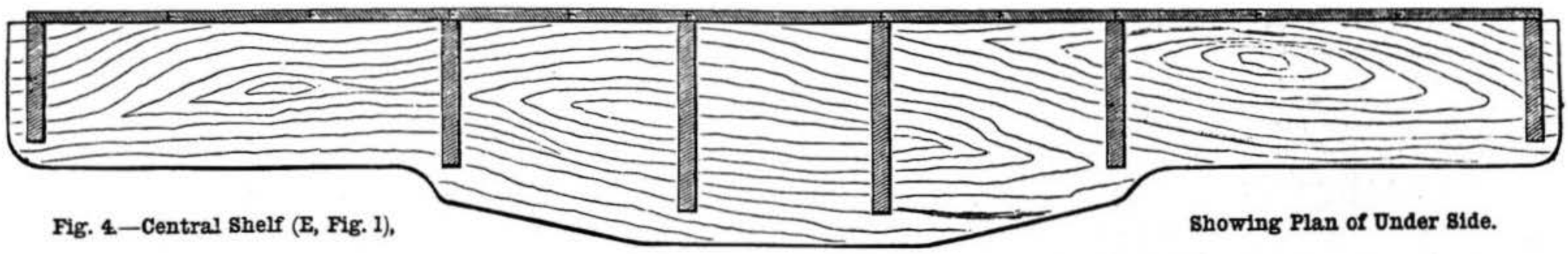

Fig. 4.—Central Shelf (E, Fig. 1), Showing Plan of Under Side.

for rendering shelves adjustable must do one of two things—it must either weaken the upright, or it must lessen the space for books. Yet, as some persons have a decided objection to fixed shelves, it may be well to mention one or two plans for supporting those that are movable. Perhaps as good as any of these is the double rack, Fig. 8. In this the movable slip, K, gives a firm support to the end of shelf, L, which has to be cut to fit upon it. This, of course, takes from the space for books a quantity equal to the thickness of the racks and slip, which can scarcely be less than a quarter of an inch. A slip of wood, near the ends of which are two projecting wooden pegs or pins of metal, made to fit into corresponding shallow holes in the upright, will save space, but it is less firm than the above plan; it is, however, to be preferred to the pair of short, stout, separate movable pegs which we sometimes see employed to carry a shelf end.

Whenever in fitting the non-adjustable shelves a want of proper books for the large compartments is found, and small books have instead to be placed in them, there is an easy method of obviating any unseemly gap between the tops of these small volumes and the dust strip. This is by nailing together three pieces of board in the manner shown in Fig. 9, and thus making a "bridge" of the length of the shelf. Its front edges should be coloured like the woodwork generally, and it will look better if fitted with a dust strip It can be made to bring the heads of the books placed upon it to any required height, whilst the space beneath will be useful for lie-down books, small portfolios, or magazines. If the height to be "bridged" is considerable, two low bridges, one placed upon the other, will be found better than one high one, as the two lie-down shelves will be much more handy than one. Such bridges are knocked together in a few minutes.

Heavy books of reference, which are frequently taken down from the shelves, are apt to suffer from rubbing on the lower edges of their covers. Hence in some elaborately-fitted libraries the shelves intended for such works are padded and leather covered. A cheaper and simpler method of protection has been found by the writer to work well; that is to give the shelf a covering of baize, or some such stuff, and above it one of smooth American leather cloth. This, though not so enduring as leather, causes even less friction, and consequent wear, of the book edges, and will last for very many years.

Whenever there is the slightest suspicion that the wall against which bookshelves are to be placed is not dry, it is always well to leave a space behind the back of the bookcase for the air to circulate freely. If there is cause for any fear beyond a suspicion, it is better, instead of matchboarding, to make the back of zinc. The cost will be much the same, and if the shelves are non-adjustable the zinc can be nailed to the back edge of every shelf. The front side will need to be brushed over with brunswick black, when it will go very well with the ebonised wood. Damp is a cruel enemy to books, and many a good collection is ruined as regards pecuniary value by not guarding against it. Simple precautions like those named above are, therefore, well worth attending to.

Everybody nowadays has books of one kind or another, since works of the highest class, that take rank as English classics, have been brought within the reach, even of those who can afford an outlay of no more than a few pence weekly on mental food in the form of books, by the issue of such works as "Cassell's National Library," in which the best works of the best writers are issued at a merely nominal price. But books, like other objects of utility, require a place to and for themselves, whether the collection be large or small. If large, the bookshelves described will afford a suitable abiding place. If small, the arrangement and spacing of the shelves may be taken advantage of for the construction of smaller

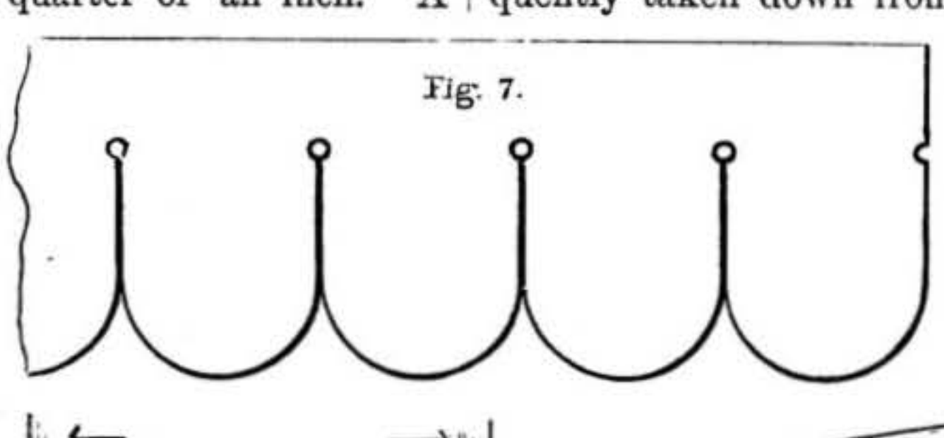

Fig. 7.

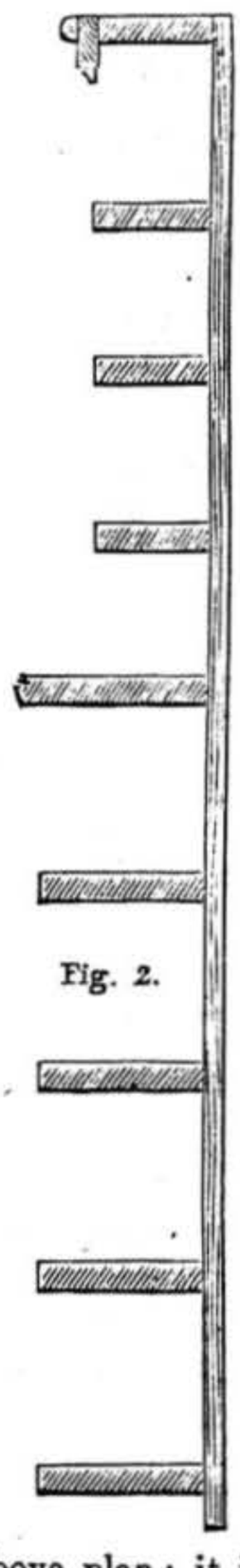

Fig. 2.

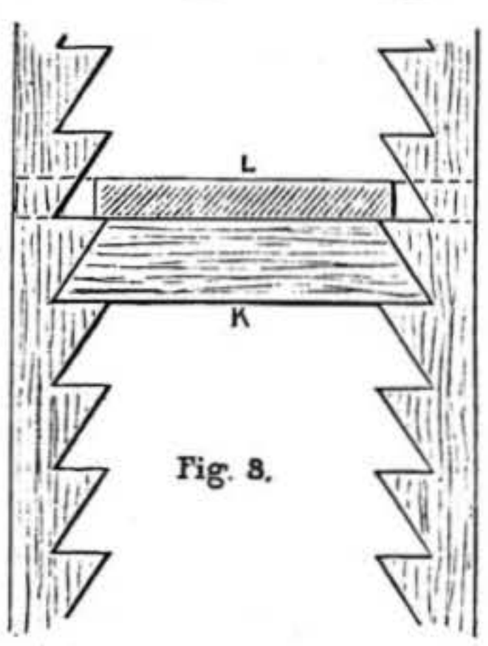

Fig. 8.

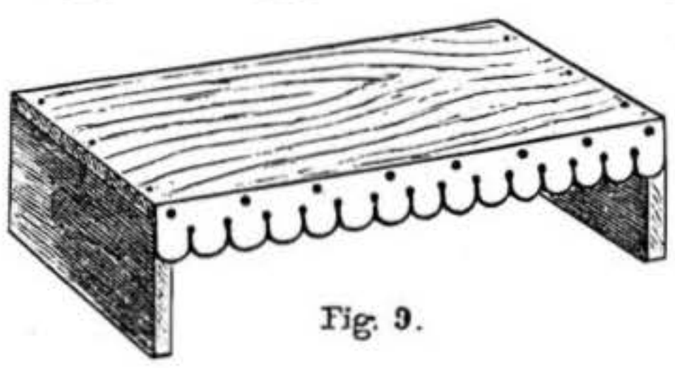

Fig. 9.

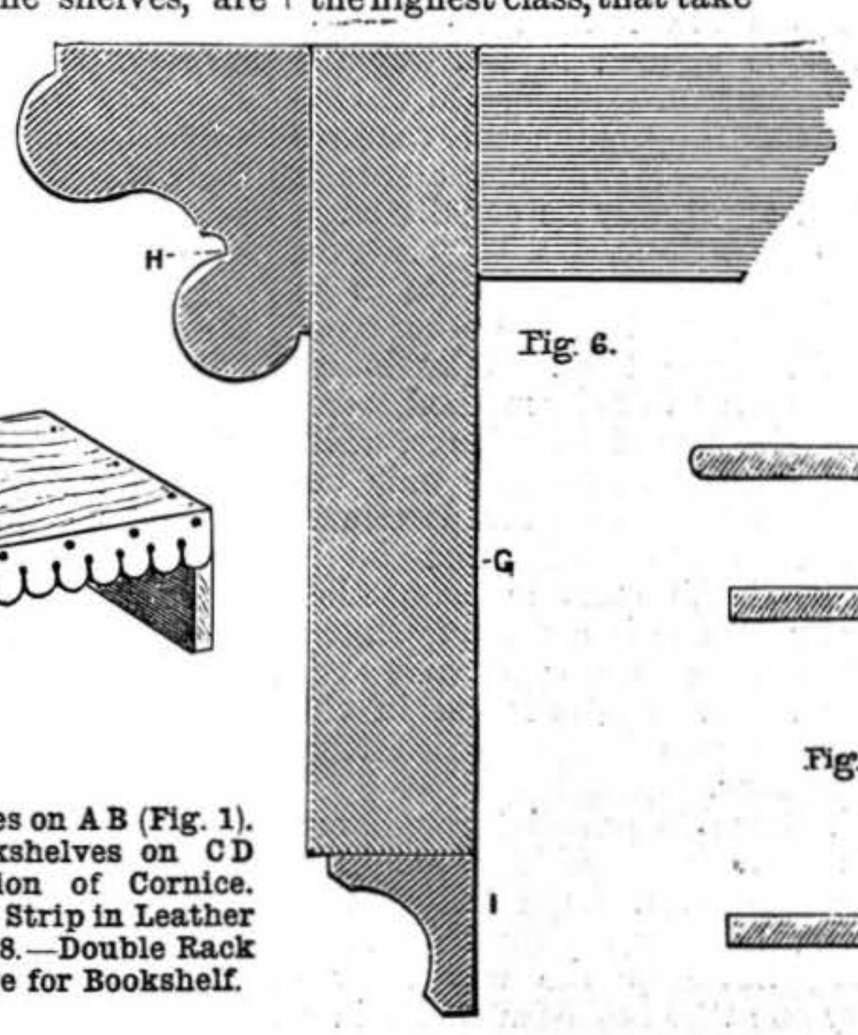

Fig. 6.

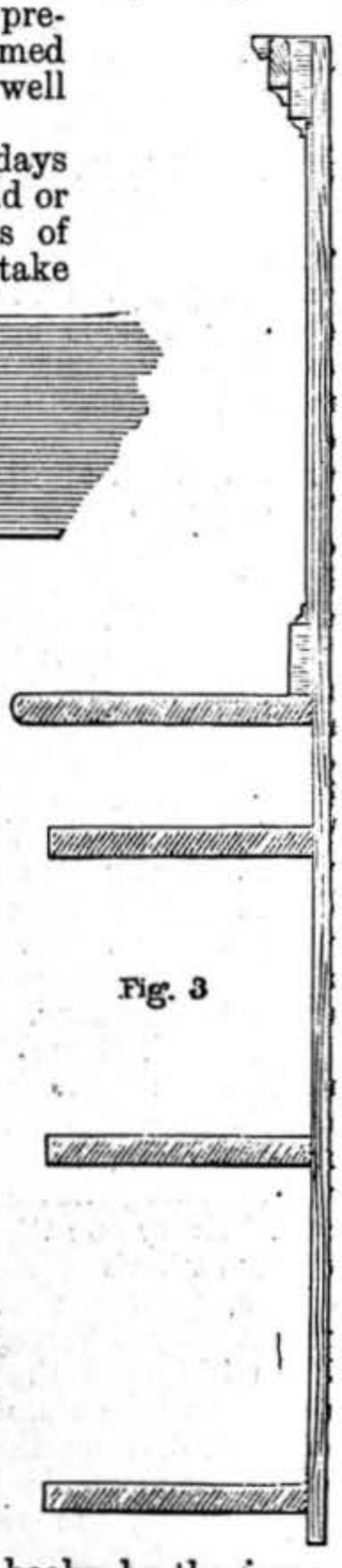

Fig. 3

Fig. 2.—Section of Bookshelves on A B (Fig. 1). Fig. 3.—Section of Bookshelves on C D (Fig. 1). Fig. 6.—Section of Cornice. Fig. 7.—Pattern for Dust Strip in Leather or American Cloth. Fig. 8.—Double Rack for Shelf. Fig. 9.—Bridge for Bookshelf.

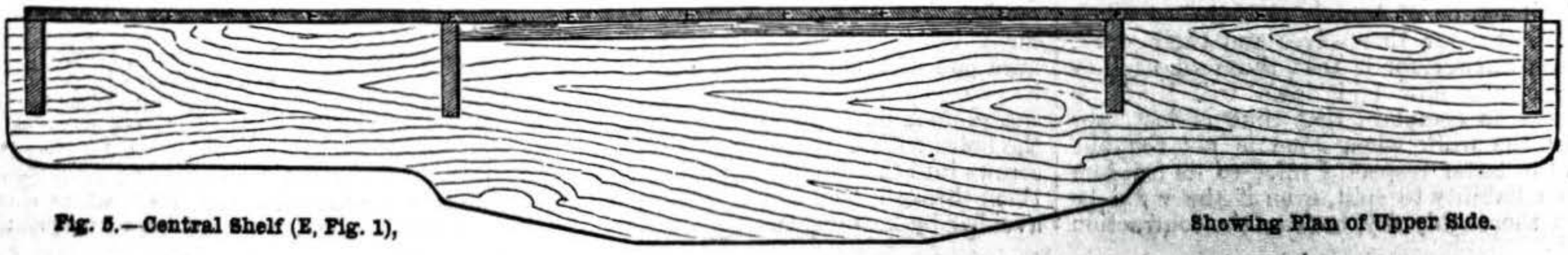

Fig. 5.—Central Shelf (E, Fig. 1), Showing Plan of Upper Side.

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sets, which may be better adapted to the space at command and the number of books to be housed, so to speak: for example, the central compartment, with simple modifications, might be used for a recess, which might be appropriated to any of the numerous purposes for which recesses of this kind are often welcomed. There is no reason, indeed, why it should not be turned into a cupboard by the addition of a door, for it is not every one who requires the space for folio volumes, or who would care to go to the expense of binding the illustrated papers of the day.

"LINING UP."

WITH A FEW CONSIDERATIONS ON ART AND ITS TEACHERS.

(*Continued from page* 211.)

METHOD NECESSARY TO PROGRESS—LINING OF TOP OF TOILET TABLE—RELIABLE MODE OF PROCEDURE—GAUGE LINES AS GUIDES—BRADS ON LINES AS STOPS—HOLES FOR SCREWS—LINING OF BACK—ATTACHMENT BY SCREWS—SECURITY AGAINST "GOING."

IT must have occurred to every observer of work in progress how much time may be saved by a little method in the way the various operations are performed. One man will take half the time another requires to get exactly the same result, although they may both apparently be equally busy. The one who gets through with whatever he has in hand first does not seem to go about it hurriedly, nor does the other seem to dawdle and waste time. Why is it? Simply because one works by method, using the accumulated stores of experience, while the slower one does not, possibly only because he may not have done the particular piece of work so frequently that he is able to grasp all the facts in connection with it. The man who is constantly at one class of work acquires a manipulative skill which not only causes admiration in the onlooker, but conveys lessons which it is unwise to disregard.

Some such thoughts passed through my mind while standing beside a cabinet-maker's bench while a small toilet table top was being lined up. Not that there was anything novel in the way it was done. Every one who has been much in a cabinet-maker's workshop must have seen it often, if not precisely in the same manner, at least only differing according to the individual ideas of the worker. Having said this, it will be almost needless to explain that the following directions do not pretend to cover the whole subject of lining up. For instance, the vexed question of direction of the grain on the end lining is not alluded to, at least, not more than by inference. The aim is more to put on record, for the benefit of all whom it may concern, a reliable method of lining up, than to advocate a new one. Those who have followed any other method—or rather let me say have become skilful in other details of manipulation, and have found the result satisfactory—have no occasion to change their style of working. If, however, they find any hints in these directions which will be of benefit to them, so much the better for themselves and their work. I can answer for it that those who follow the course now laid down will have no reason to complain that time is lost, nor that the work when done is not reliable. In the latter respect, I refer to its freedom from liability to split, even if the wood be not thoroughly dry, or from the contraction and expansion which all woods, however dry they may be, are more or less subject to under varying conditions of the atmosphere.

On the bench let us suppose the unlined top lies, bottom upwards, properly squared, and cut exactly to size. The linings are to be set back from the edge, say, ½ in., the distance, of course, depending to some extent on the mouldings which are to be subsequently worked. Whatever the distance, however, run a pencil or gauge line of some kind as a guide to plant the linings down by along the front and two ends. The lining pieces will be of, roughly speaking, 3-in. width. One of them—that for the front—must be cut with mitred ends of exactly the required length; the other two only require one end of each to be mitred, and may be left a trifle full. If they project at the back they can easily be trimmed down afterwards. The front piece is to be glued down, and to regulate its edge to the guide line is certainly possible, but if a couple of brads or wire nails are driven in on the line, one near each end, they will serve as a stop for the front edge of the lining. It is only necessary then to put the piece, after it has been glued, on the top, pressing it both against this and the nails, to ensure its being absolutely in its right place. It is almost impossible for it to slip while the hand screws are being applied, and awkward fumbling to get it truly placed is avoided. As quickly as may be, the hand screws, which have been lying conveniently near, are applied.

If the nails as guides are serviceable for the front piece, they are equally so for the others; but, of course, none but the veriest tyro would in ordinary work think of gluing these to the top. They must be nailed on, or to put the matter more definitely, be screwed down. Very likely there may be some who, when they read this, think that it is not necessary to tell them how to drive the screws in. All they have to do is to bore a hole through the linings into the top and screw up. Quite so; that is all, and experienced workers will know the proper way to act in the circumstances; others will act as if instead of joining two pieces the screws were being used in one piece of solid wood. They will make the hole of the same diameter both in the lining and in the top, *i.e.*, the same bit or gimlet will be used throughout. The result may be satisfactory in the long run, but the chances are very much against it being so. No; if the work is to be reliable, the natural play of the top piece must be allowed for. On a narrow top it is not great, and provision may be made for it by boring the holes in the linings sufficiently large for the neck or plain part of the screw to fit quite loosely in them. The holes may, indeed, take the form of an oblong slot, but it is seldom necessary that so much precaution should be taken, and if not necessary time is wasted in forming them.

Let the hole be as large as it well can be; that is to say, just so that the head of the screw shall not be able to pass through it. Now it will probably occur to most workers that the holes can be bored through both pieces of lining at the same time with greater economy than through each separately. The size of the screws has necessarily been determined beforehand. Then take one of the pieces and lay it down in its proper place. Holding it firmly against the guide nails or pins with one hand, make the holes with a proper-sized gimlet for the screws into the top, taking care not to bore them through, a mishap which can easily be avoided by keeping the fingers underneath as the boring proceeds. Touch the mitred end with glue, place in position firmly, and screw up. A hand screw should be placed so that it grips the three pieces, top, front, and one end at the mitre.

The other end, of course, is treated in precisely the same manner, the hand screws being left on till it is judged safe to remove them, which will be when the glue has set.

The guide nails can be removed at any time after the pieces have been planted on.

There is still another piece of lining to be considered, viz., that at the back. It is cut with square ends, so that it lies within the two end linings, between which it should fit exactly, especially if the back is ever exposed to view, as it frequently is in dressing tables placed in a window. If the back of the job is to be against a wall, precision is not so necessary, though even then slovenly fitting should be avoided. The back edges of the top and the lining here will, in the vast majority of cases, be better if flush than if arranged with the top to overhang.

The back strip of lining may either be glued or screwed, according to the way the top is fastened to the stand or whatever it is to form part of. A moment's consideration will show the reason why. If the top is screwed or blocked down at back and front so firmly by the linings at these parts as to be bound and immovable, the provision which has been made by leaving the side linings free to allow of play in the top will be completely nullified—that is, supposing the back and front linings are both glued to the top. The conclusion, therefore, is that the back lining should be fastened to the top with screws, and that these should fit loosely at the necks; or, that if glue is used, the necks of the screws fastening the lined-up top to the job must fit loosely. To sum up about this part, it may be said that though the experienced worker may safely be left to decide for himself which course to pursue in any given case, the novice can hardly err by using screws instead of glue, always remembering that if screws are used to attach the lined-up top to the work, they must not penetrate beyond the lining into the top itself, unless their necks fit loosely. Enough has now been said to show how a lined-up top may almost to a certainty be insured against "going," which, for the benefit of those who do not understand the word in its technical sense, may be told is merely short for "going wrong." The grand secret to avoid this in lined-up tops the reader either is already aware from his own experience, or will have gathered from the foregoing instructions, is not to "bind" the top, but let it have free scope for natural play.

In describing the practice or way of going to work that ought to be followed, I have endeavoured to combine theory with it as far as possible, by showing, or at all events trying to show, the reason for taking each step in sequence in the operation from first to last.

OUR GUIDE TO GOOD THINGS.

55.—SYER'S JOINER'S CRAMP.

IN the present number of WORK I am enabled to call attention to some of the specialities of Messrs. Thomas I. Syer & Co., engineers, tool and workbench makers, 45, Wilson Street, London, E.C., and I have all the more pleasure in doing this because it gives me an opportunity of saying that Mr. Thomas I. Syer himself is the principal of the Finsbury School of Practical Amateur Mechanics, whose workshops are in Finsbury Square Buildings, Chiswell Street, E.C., where classes are formed with the view of imparting practical

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instruction in elementary carpentry, cabinet work, wood carving and engraving, plain and ornamental wood turning, and metal working. Mr. Syer will also form classes for French polishing, upholstery, and fret cutting, as may be required, and will send prospectuses with terms and all particulars to any applicants. Private tuition is also given at any hour of the day in carpentry, cabinet making, turning, and carving. Mr. Syer is assisted in the several classes by competent instructors. The next term will commence in October, 1889, and I believe I am correct in saying that the class-rooms will then be found at 45, Wilson Street, Finsbury, E.C., Messrs. Syer & Co.'s new house of business. To return from this digression to

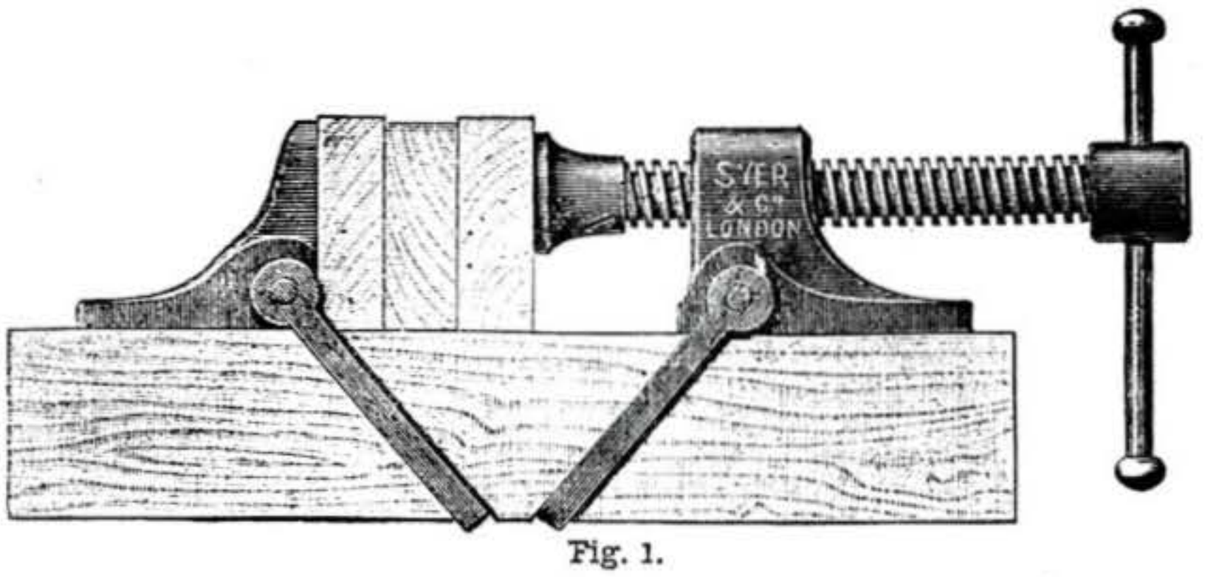

Fig. 1.

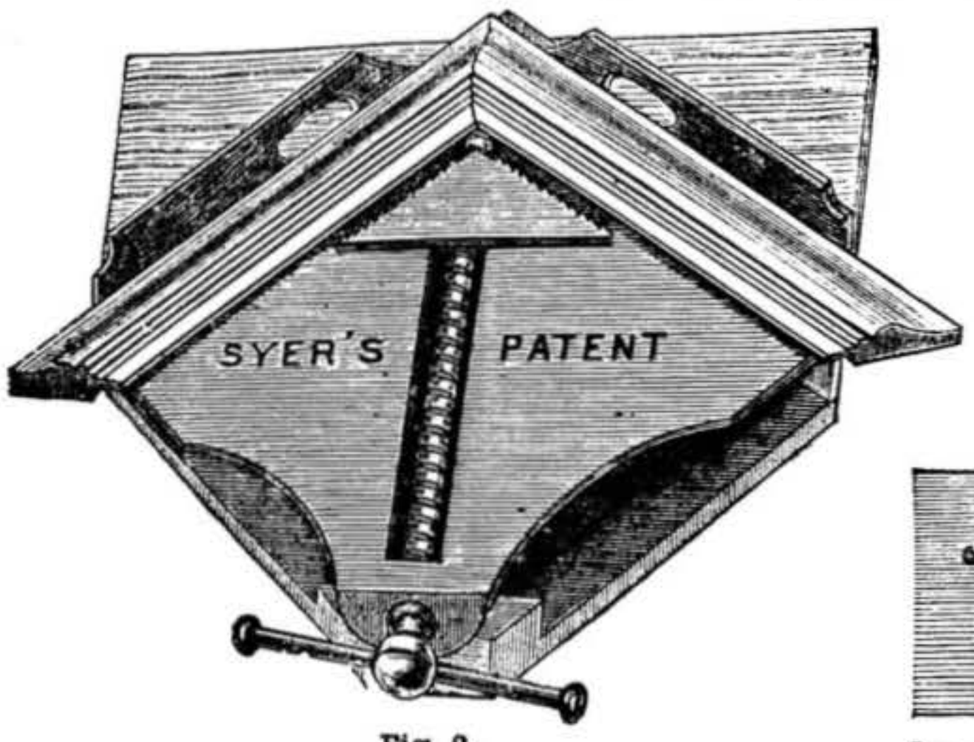

Fig. 2.

the joiner's cramp. The nature of this appliance will be understood from Fig. 1. It comprises a pair of metal heads made in three sizes:—No. 1, to fit over 3-in. by 1½-in. wood bars, and capable of being used up to a length of 6 ft.; No. 2, to fit over 4-in. by 2¼-in. bars, and effective to a length of from 10 ft. to 12 ft.; and No. 3, to fit over 5½-in. by 3-in. bars, and effective up to any length that the strain of the timber will stand—that is to say, speaking approximately, up to from 20 ft. to 24 ft. These are much used now by builders for very large work, as they are light and can be easily packed with the carpenter's kit. The prices of the three sizes—Nos. 1, 2, and 3—are respectively 8s. 6d., 11s. 6d., and 16s. 6d. per pair.

56.—Syer's Patent Universal Mitre Cramp.

This excellent appliance, useful alike to picture-frame makers, cabinet makers, and joiners, will secure any mitred joint true. Its principle is clearly shown by the illustration in Fig. 2. The cramp itself is first secured to the table or bench by G cramps or hand screws, and then the ends of two of the pieces that are to form the frame are planed up, if necessary, after being sawn or otherwise cut, and the pieces placed in the cramp as shown. The handle at the bottom of the cut is then turned, and by the action of the screw the triangular plate is pushed forward against the rebate of the moulding. The pressure of the plate is sufficient to close the joint and hold the adjacent pieces firmly enough to allow the nails to be inserted. It will be noticed that the pieces are held by the plate against the sides of the cramp, which do not approach each other so closely as to prevent the insertion of the nails. These cramps are sold at 21s. each, on wood stand; and at 23s. 6d., on well-finished stands of mahogany or oak.

57.—Syer's Patent Bench Knife or Back Stop.

The action of the Knife or Back Stop is shown in Fig. 3, which is placed in position on the bench, a pin on the other side of the plate and not seen in the illustration being dropped into

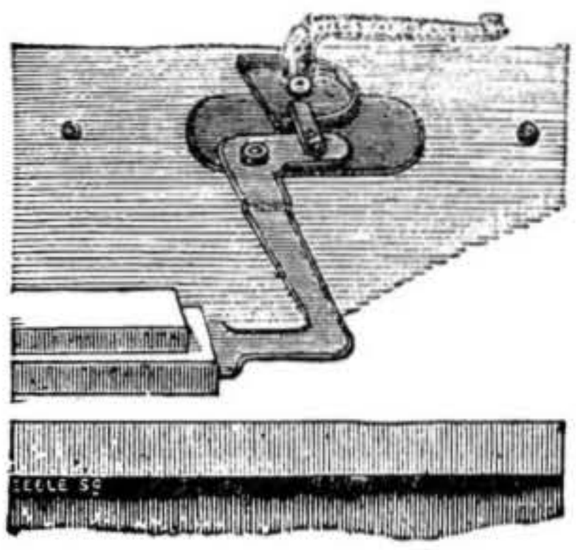

Fig. 3.

one of a series of holes made in the bench for its reception. The handle, which in this appliance is horizontal instead of vertical, as in the old pattern, is then pressed or pulled, and the bench knife is then pressed with force against anything that it is required to hold, the piece of wood, or whatever else it may be, being placed between the bench stop and the bench knife. These bench knives are sold at 3s. 6d. each.

58.—Brown's Patent Tool-Grinding Rest.

The Patent Tool-grinding Rest in Fig. 4 is suited for use on either hand or foot or power stones. As in the other appliances, the construction is apparent in the illustration. Two angle pieces of metal are fixed to the support or trough of the grindstone on opposite sides. Each of these carries a slotted arm, fixed to it by a fly nut. To the arms another iron framing is attached by the same means, and on the inclined piece in the centre of the framing the tool is supported during grinding. The slope can be fixed at any required angle, and the same slope can be easily obtained after examining the edge of the tool being ground, which cannot be guaranteed when tools are held by the hand only. It is made for and can be attached to any grindstone, wood or iron; and any person, however inexperienced, can use it. The price for wood trough and for stones up to 4 in. thick is 10s. 6d.; for iron troughs and stones of same width, 12s. 6d. A clamp for gripping tool on rest is supplied for 2s. 6d., in addition to the prices named.

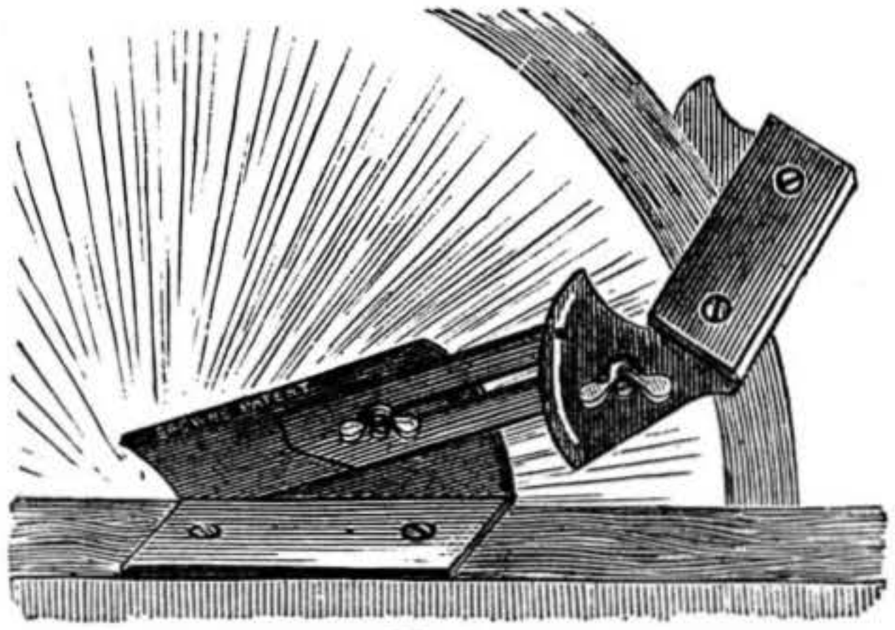

Fig. 4.

59.—Syer's Registered Portable Work Bench.

This handy bench, which is illustrated in Fig. 5, is constructed in such a manner that it may be taken to pieces and quickly put together again with an ordinary spanner. The supports are of metal, which imparts extreme rigidity to the bench when all the parts are bolted together. The top is of deal, and is, in the bench illustrated, 6 ft. long and 22 in. wide, but other sizes may be had if desired. It is firmly bolted together from side to side, which prevents warping. The height is 30 in., and the bench at this height and size of top already mentioned is supplied at £3 12s., but 1s. extra is charged for every additional inch in height. It is fitted with an instantaneous grip vice of the B pattern, with improved loose handle. With this vice, by a single movement, the wood can be immediately gripped and as speedily released. In front will be noticed a vertical board pierced to take pegs to support boards when in the vice. The bench is further fitted with a screw-rising wood stop of improved pattern, which can be easily raised or lowered to the required distance, and with the patent bench knife, already noticed, for which a series of holes is bored in the top to admit of its application to wood of any length. A strip of wood is shown in position on the bench between the bench stop and the bench knife.

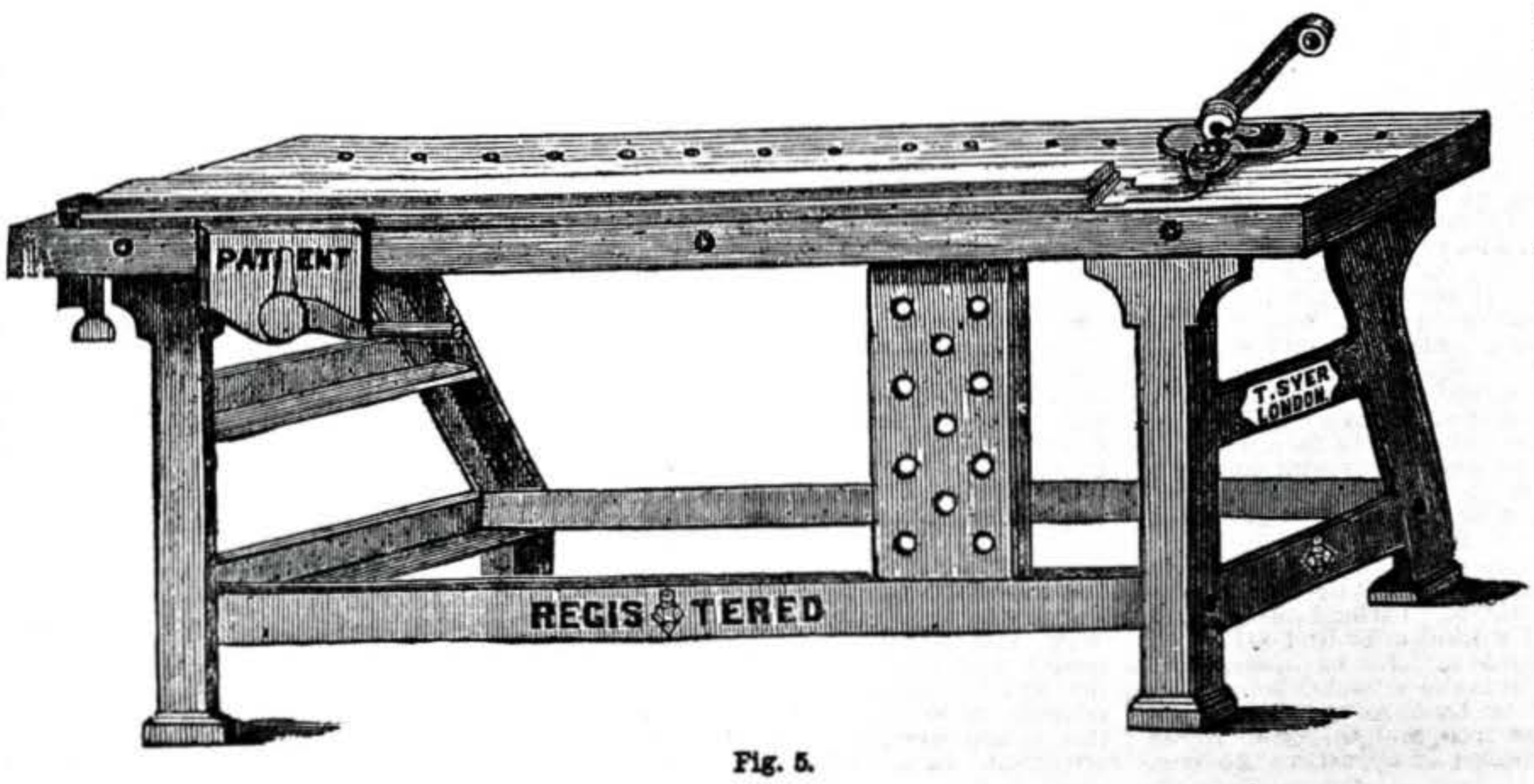

Fig. 5.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** *All Communications will be acknowledged, but Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Work.—S. H. E. (*Plymouth*) writes:—"As a workman I desire to thank you for the production of Work. I believe that it supplies a long-felt want, and, therefore, I wish it all success. There are several features about it which are quite unique, two of which I may mention. One is its scope—treating, as it does, of all kinds of work done by man; and the other is its thoroughness of treatment of each individual subject, even down to the most minute details."

Subjects in Work.—Scriptor writes:—"I beg to congratulate you on the success of your paper. It is a great favourite in this district, and most helpful."—[I am glad to hear this, especially as you write from Ireland.—Ed.]

"I trust you will be able to give a few papers on the construction of good, honest furniture; not the gimcracks which find so much favour with a certain section of the community, under the name of artistic. What I want is good strong chairs and tables—such as are to be bought in shops. A sideboard is on the *tapis* just now."—[Furniture, plain and strong, and, I trust, not altogether ugly by reason of its plainness and strength, will not be neglected; but our "artistic" furniture is by no means to be classed with gimcracks.—Ed.]

"Why is it that engine boilers are never described in magazines like Work? Are they too difficult for amateurs to attempt, or is it dangerous for the stoker afterwards? If so, I think you might set up an insurance office for those who come near amateur boilers, and then it would be all right."—[You must make terms with some accident company for a policy of insurance, especially as a contributor has an engine boiler in hand.—Ed.]

"French polishing would also be very acceptable to me."—[You shall have it.—Ed.]

"Kindly remember, Mr. Editor, that I do not wish to have a few years of Work suddenly published in one number for my special edification. These are merely suggestions, and I will wait for them with what patience I can; in the meantime giving place to more worthy readers. I will do what I can, however, to perpetuate your magazine, lest it should come to a sudden smash, and so deprive me of one of my pleasures on Thursday mornings."—[Work is so firm on its legs that there is no fear of your Thursday morning pleasures being brought to an end by a burst up, unless the engine boiler happens to go that way.—Ed.]

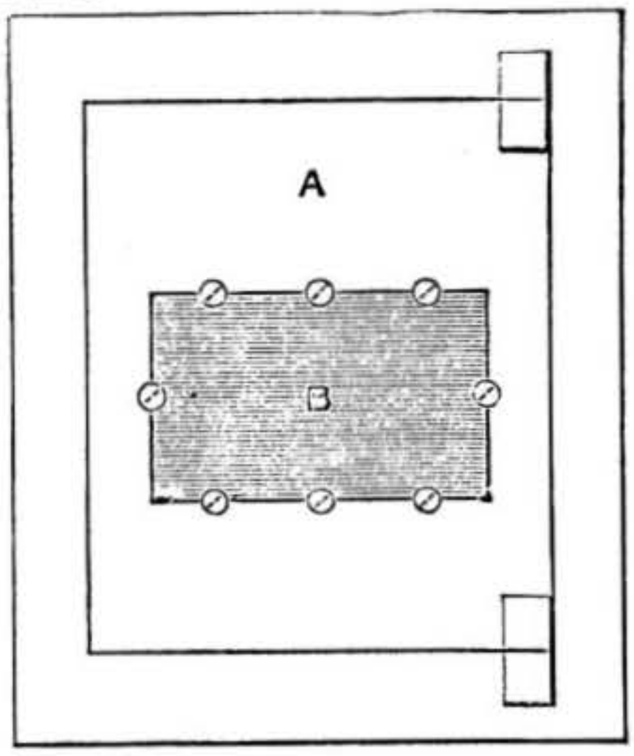
"When writing to friends I enclose one of your prospectuses, which I think a good plan. I am afraid they sometimes think I am an agent for its sale, which I am not."—[No, but being enthusiastic you do as much real good as any agent, and help the agents themselves. Please go on sending prospectuses.—Ed.]

Wire Thread Fret Saw.—H. J. (*Shepherd's Bush*) writes:—"In accordance with your request in your appreciated paper, I have this day searched the indices of 26 vols. of the *Scientific American* at the Patent Office—viz., from 1870 to 1882—*re* the wire thread saw, and fail to see any mention of it. Perhaps O. F. could give a little more definite information as to the date he saw the article."—[I am truly obliged to you for taking so much trouble, and regret you should have had so much labour to no purpose. Possibly it may be mentioned in the *Scientific American* under some other name.—Ed.]

Suggestions for Work.—H. J. (*Shepherd's Bush*) writes:—"I am very pleased to have such an organ on behalf of work as you are bringing out—such a thing being well needed; but I should be far better pleased, and I have no doubt many others would, if some of your correspondents would bear in mind that your title is Work, *pure* and *simple*, neither for amateurs, professionals, nor apprentices; and frame their articles in a more simple matter-of-fact style, catering neither for one class nor the other, but for *workers* as a whole."

Home-Made Power Machine.—H. J. (*Shepherd's Bush*) writes:—"If you can see your way at any time to grant such, I would like to see an article (or series) on a *home-made* foot power machine that could be adapted to circular and scroll sawing, boring (wood), say, up to 1 in. in diameter; sawing, say, 3 in. or 4 in. of hard wood; and that could also be used for drilling and polishing metal, turning, etc. It seems to me that with different attachments all could be utilised with the same motive power (and which I would suggest, with its frame, should be described first, followed by its more important adjuncts in due order), though, of course, not all at once. An edge former or shaper might also be included—in fact, a sort of 'general joiner' for both wood and metal to a certain extent. Timber is cheap, and a handy man might rig up a machine at odd times that would, perhaps, turn out work to vie with a more highly finished affair costing £20 or £30 or more, and which he may never have if he has to wait till he can save up enough to pay cash down. I would also be glad to avail myself of J. H.'s kind offer and ask for a supplement to his valuable articles on home-made tools, describing how to make a metal smoothing plane with wood sole or base, as wood does not hang to the surface like iron, and therefore works easier; and if some means of adjusting the iron with a screw instead of by hammer, without infringing on other patents, so much the better."

Safes and Safe Locks.—Inquirer (*Hull*) says:—"I am a whitesmith and locksmith by trade, and it often happens that some one has lost his safe key, and requires his safe opened and a new key. We used at one time to drill a hole through the door just where the bolt head of the lever lock comes, and force the bolt back; or, failing this, drill the head of the bolt clean away, and the door opens easy enough then; but now they are made with a hardened steel plate immediately behind the door, which we cannot drill; and the last one we did, we had to find the edge of the steel plate and drill it completely out, which, of course, means a new plate and a piece fitting in the door, which we fixed in its place by putting screws between the joints thus:—



I have taken Work every week, and enjoy the 'Shop' corner very much; and I believe you are ever ready to help a young hand where you can; and what I want to ask your readers is, can they tell me a better way of opening a safe than the one described? The shop in which I work I served my apprenticeship, and there is only my master and I at work, and therefore I have had no opportunity of seeing any other man's ideas; and I should feel deeply indebted to you or any one who could tell me a good method of opening the safe. Also, I am told that in London they make safe keys to any key sent to them, which we do not do here in Hull, as we always take the lock off. Is there any book published that would give me any information on this subject?"

Another Encouraged One.—A. W. (*Liverpool*) writes:—"I had the good fortune to come across your excellent publication the first week it was issued, and have hailed every succeeding number with increased interest. This fact may surprise you when I say that I have never been a workman, either professional or amateur, circumstances, 'when I was much younger,' having turned my career into a channel which nowadays offers little inducement in the matter of remunerative occupation. I will tell you how I account for the interest I take in Work. From my youth upwards I have always been fond of reading, and subjects connected with science, the arts, etc., were always the most attractive, among my first speculations in the way of books being Cassell's first series of Popular and Technical Educators; these, supplemented by evening classes in physics, mechanics, etc., whetted my appetite considerably. I have also visited workshops of various kinds, and always tried to learn something of tools, etc., when I could get the chance. You will see, therefore, that the foundation of my interest in Work is not altogether built on sand. Now, the advent of Work has raised a new hope within me—it has revived the latent yearning of years to be of more use to myself and those dependent on me; and I believe firmly that it will put me in the right direction. Your subjects are so clearly explained and illustrated that the average common-sense man can hardly fail to comprehend them. The advice and encouragement in which your journal abounds seem specially intended for such as myself; therefore I have ventured to address you at such length. Your reply, however, to H. D. (*Bury, Lanc.*), No. 6 issue, gives me a hope that I am not trespassing too much on your kindness. I also notice with particular satisfaction your reply ('New Inventions') to W. J. P., No. 8 issue; the position described is much the same as my own. I have had ideas from time to time which may or may not have been of value, but lack of means to develop them has always put the damper on. Your sympathetic remarks, however, to W. J. P. come like a gleam of sunshine. Some months ago I completed an idea in connection with domestic ventilation. I have not been able to learn, so far, whether my idea has been anticipated; therefore the principle and application of the appliance I shall submit is original to the best of my knowledge. With your kind permission I shall send a rough model with explanations when I hear from you, through Work or otherwise. If through Work, address A. W. Kirkdale, Liverpool. I am afraid this communication is too lengthy to merit your attention. In any future correspondence, however, I promise to confine my remarks to the subject in hand."

A Subscriber's Testimony.—C. S. (*Radford*) writes:—"I might say in passing I am highly pleased with your Work. I waited for No. 1 with some impatience, and I consider it a long-felt want. It has come up fully to my expectations, and I wish it every success, which I am sure it deserves. I am doing some fretwork, and am going to compete at an industrial exhibition. I had so much on hand, I am sorry I had not time to make your cabinet for it."

Building Construction.—G. S. R. (*Tewkesbury*) writes:—"In reply to your request for the opinions of your readers, *re* plans, etc., for building, may I urge you with all my heart to carry out this suggestion? I know of others in my own profession who are placed as I am—that is, anxious and able to get their own house, but not able to meet with just what we want ready built. For months I have been thinking out and drawing plans for a residence—two-storey, with seven or eight rooms—and have drawn and redrawn them, as improvements came to me, but am still not satisfied. Now your splendid paper is just what I want in this direction. Its excellent articles on panelled walls and ceilings helped me greatly, and I intend having part at least of my new home left in the rough from the bricklayer's hands, so far as walls are concerned, and decorating by your valuable suggestions. In this connection may I ask whether a ceiling so treated would, or would not, look darker and heavier than the ordinary sort? Also, may I trouble you for your advice on this point? If the wall panels could be so made as to be covered with a sheet of glass, which should be kept in place by a removable fillet, would it look well or be bad taste to fill each panel with some picture, say a mount with photos, or a scene, etc.? If in accordance with good taste, I can see many developments of this idea. If you have room to reply, kindly do so to my initials. In conclusion, let me very heartily thank you for Work. I can't say all I think of it, but if you knew how I treasure each number, and eagerly look for each new one, you would tell how truly valuable I feel it. On the completion of a volume, could you not prepare suitable covers for binding the numbers in? I intend having mine bound and preserved as one of my most valued books. When is the new kaleidoscope to be described?"—[The ceiling would of necessity look a little "darker and heavier" than the ordinary flat whitened expanse so called, because shadows would be cast by the beams or *quasi* beams. The description of the new kaleidoscope will appear shortly.—Ed.]

Dyeing Osiers.—P. W. S. (*Poplar*) writes:—"On page 78 your conjecture that aniline dyes may be used for dyeing osiers is correct. That plan is preferred to staining for the more vivid colours."

Building Construction.—Plumstead writes:—"With very great pleasure I have read in 'Shop' of your last issue of Work, in reference to plans, etc., for building, and would be extremely thankful to you to take up the same. I am about to lease a piece of ground of 40 rods, and want to superintend the building of a four-roomed house myself thereon with 15 ft. frontage. Seeing you would like to have the mind of your readers, I have ventured to write you. I am sure I have the same views as your correspondent: that according to the past and the valuable help Work has been to me, your information would be most valuable."

Sale and Exchange Column.—Constant Reader (*Bristol*) writes:—"I think that all amateur workmen should be obliged to you for publishing Work. I have got several men to take it in, and they are very pleased with it. I think if you would open an exchange column for readers it would pay you, and I hope you will shortly bring out a cheap way of electric bell-making for house purposes."

Japanese Fretwork, etc.—Waiting writes:—"I congratulate you on bringing out such a useful and interesting little paper as Work. A teacher by profession, I spend a deal of my spare time in a workshop in the winter time, and in the summer I turn to brush and pencil. I have amused myself for the past five or six summers with water colours, but this year, with the return of the swallow, I began to try painting in oils. I find paints, brushes, and canvas rather heavy, having a very limited income, and have tried to make my own canvases. I cannot get a smooth surface, and it struck me I could get to know through Work how the thing is done. I make a frame, stretch the canvas over it, size it, and then give it a coat or two of ordinary paint, but it does not turn out so well as bought ones, and I think I am perhaps wrong somewhere. If you would be good enough to give me this information through your paper, it may also help some other struggler. I hope you will soon bring out an article on painting. I am watching for it. I intend trying some of your fretwork patterns next winter. I like the Japanese patterns very much. The cornice design was beyond me. I haven't tools enough. I wanted one, but got three yards of tapestry, a length of felt moulding to go along the top, and cut some corner pieces in fretwork, which I covered with gold leaf, and made a capital one."—[Instructions on house painting will be given, but not on painting in oils for landscapes, figures, etc., as there are so many good text-books already in existence on this subject. You will find the Japanese patterns for fretwork, etc., very suggestive and useful. You have managed to make an attractive temporary cornice, but I am afraid you will not find it very durable.—Ed.]

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II.—QUESTIONS ANSWERED BY EDITOR AND STAFF.

Overhead Motion.—H. E. W.—If you have a fly wheel of 24 in. with a V groove I should recommend the overhead described in No. 8 of WORK; but if not, you might adopt that illustrated at Fig. 6, p. 92. The main shaft of the overhead may be about 1 in. in diameter, or ¾ in. if of steel. The drum is made of wood with brass caps at each end; it is built up like a barrel, and need not be more than 12 in. long to fix anywhere on the shaft; it may be 6 or 8 in. in diameter. The standards are of cast iron of elliptic section; the triangular section tie-bar at the top takes the thrust of the centre screws on which the main shaft turns, and it checks the fall of the weight if the band comes off. Weight may be about 4 in. in diameter. The overhead of the London Lathe and Tool Company, to be illustrated shortly, is a very good one. Adopt whichever of the three you like, and you will do well.—F. A. M.

Fret Cutting.—J. M. (*Perth*).—Trace the pattern with ink on ordinary tracing paper, and paste it on the wood; this avoids injury to the design itself, and is easier to work from. But if your knowledge of fret cutting is so slight I should not recommend the design referred to for some time yet.—J. G.-W.

Egyptian Trellis Work.—H. C. T. (*Newcastle-on-Tyne*).—I know of no firm in London selling this class of work. There is no great variety of pattern in the trellis work; the Egyptian is satisfied, as a rule, to repeat the same pattern continually. I have, I fancy, as many specimens of the work as are made; but, on looking round, I really do not think I have three distinctly different patterns. Variety is produced by the introduction of pillars alternating with the stars, the shape of the beads, etc., and the different colours of the woods used. The drawing you send is the staple pattern. I have, in papers about to appear in WORK, produced all the varieties of detail I have seen. The art is in the grouping of the patterns and in the designs of the brackets, etc., into which it is introduced. I hope, in the series of papers, to satisfy such inquirers as yourself. I am glad that my contribution has been the means of causing an interest in WORK. I am sending specimen copies to brothers in India, Australia, Demerara, and Yorkshire, all of which will, I hope, lead to new subscribers joining, as I shall ask each brother to show it to any likely friends. The fact of your doing work for a London firm in your own northern town would seem to prove that there is no firm in London who have taken up this style of work.—C. H. O.

[To this I may add that a caterer for furniture makers to whom I was speaking of the Egyptian trellis work the other day as a means of ornamentation that might be used with advantage in a variety of ways, threw, or tried to throw, cold water on the notion by saying that this kind of thing had been overdone in London, and that people were wearying of it. I still think, however, as I thought before the *douche* was applied. Having the principle of the work, it is possible to apply it in any number of forms by pressing differently shaped blocks and spindles into the service. For example, take a number of equilateral triangles as blocks, and connect these flat blocks by turned spindles, and see what a quaint but highly effective trellis you will get, especially for outdoor work, for which this kind of ornamentation is very suitable, and a great improvement on the crossed lattice of every-day carpentry. If any of the readers of WORK, in making experiments in quest of patterns, hit on any combination of a striking and effective character I trust they will send their designs for publication.—ED.]

"Turning for Amateurs."—H. P. (*Canterbury*).—This elementary work, suitable for beginners, by the Rev. James Lukin, to which reference was made in No. 4, p. 51, is published and sold by the Britannia Company, Colchester.

Organ Building.—E.—In the papers on American Organ Building that are now in preparation everything that is of importance in the trade will be touched on, and made perfectly clear to the beginner.

Obtaining Patent.—J. S. (*Bristol*).—In making application for a patent it will be necessary for you to give your own name and address, and not to apply under an assumed name.

Brass-capped Bradawl.—D. W. M. (*Cork*).—These bradawls are supplied, carriage free, at 3s. per dozen, assorted.

Soda Water Machines.—W. H. C. (*Belfast*).—There is no intention at present of touching on the manufacture of machinery used in the preparation of aërated waters. Should it appear, however, that there is a widely spread demand for the description of such machinery, an effort would be made to meet it. I have said all I can say with regard to the advertisement pages in WORK, and can only repeat that if it be found possible to meet the wishes of yourself and many others with respect to these it shall be done.

Cleaner.—OIL.—The best oil for clocks or watches that I know—and I have now had eighteen years in the trade—is Kelley's, to be had of Grimshaw & Co., 33, Goswell Road, Clerkenwell, London, E.C., 1s. a bottle; or, I believe, by the box of a dozen, cheaper. State if clock or watch when ordering; it does not thicken, like most oils, after a few months. If unable to get it, I will gladly do so for you.—A. B. C.

Photographic Camera Making.—TRENCH.—This will not be neglected, but I think you will agree with me that this is best brought forward in the winter season, when photographers who can use tools can be at work for the ensuing spring and summer.

Tightening Chair Backs.—TRENCH.—Send a sketch of the kind of chair whose back has gone wrong, and show clearly what is amiss with it, and you shall have help. If directions are given in the dark, it is possible that they may in no way apply to the damage in your chairs. In asking advice in repairs it is always needful that the general build of the patient and symptoms, whether of fracture or of general debility, should be set clearly before the chair-doctor.

Column for Beginners.—TRENCH.—You want to get a knowledge of the first principles of carpentry rather than to have papers on making boxes, trays, and things of that sort. You will learn more by making the overmantel and secretary already described than in turning out a few simple things, for, after all, the sawing, planing, and putting together are the same in the one case as the other, or very nearly so. And in making your first article, pay a carpenter to show you how to use and sharpen your tools; you will find it money well spent. Nevertheless, your desire for a few small things shall not be forgotten.

Division Plate.—H. E. W.—You wish to fit one to your 5-in. lathe with back-gear, which has a wheel of only 5 in. in diameter; you say there is no room on the gear wheel, but that the wheel might have been 2 in. larger. I must conclude, then, that you are cramped sideways. I had a plate fitted in a similar situation by cutting away the casting of the headstock with the chisel, and so got in a division plate $\frac{1}{16}$ in. thick, made as a ring, so that the nut for securing the pulley to gear wheel could still be reached; a recess, or rabbet, was turned in the inner edge of the rim of the gear wheel, and the plate, or rather, ring, was turned to fit, and secured by rivets, which came between the rows of holes so as not to interfere. If you cannot possibly get your plate in thus, perhaps you could mount it on the tail end of mandrel, provided it comes through at the back of the headstock. As to the size and numbers of the holes, shape of division peg, etc., I think you will soon see an article on the subject. If you mean by "striking out" that you think you can set out the holes by compasses, I don't think you can make a division plate worth having that way.—F. A. M.

Wrought Iron and Steel Girder Work.—FEN MON.—You express a hope that the papers on this subject will be discontinued, because "there are plenty of journals devoted to the iron trade that better suit it, while more of the ornamental, the arts, and sciences seem more congenial to WORK." Yes; but how about the readers who ask for and like papers on the subject? It is impossible to ignore any subject because some are found who do not take an interest in it. Moreover, papers devoted to the iron trade are trade papers, and are purchased by masters and not by the men, and they do not enter so thoroughly into the construction, and explain the why and the wherefore of matters as completely and intelligibly to the young workman as the writer of these papers does. WORK is intended to be a good paper all round for masters and men, but more especially to enable workmen to get at the theory of their own trades through the practice described. To produce a paper that shall be equally interesting in all its parts to everybody is morally impossible, for nobody exists who has not his or her preference or proclivity both in work and play; so the next best thing is to endeavour to make a paper that is intended for all as interesting as possible to the majority of the readers. And if you are in the minority one week, you will be pretty safe to be in the majority the week after.

Patent.—AMATEUR (*New Southgate*).—To obtain a patent for your invention you must apply for it upon the prescribed forms at the Patent Office. These forms include a declaration, to be signed by the inventor, that he is the "first and true inventor," and the two other forms upon which the duplicate specifications must be commenced. These specifications must fully explain the meaning and the intention of the inventor, and be accompanied by sheets of drawings, when required, also in duplicate, and executed in Indian ink, with a very black line; and the specification must refer to these drawings, which are taken together to indicate the invention. No ambiguous language must be used, and the specification must commence with a *title*, and conclude with a distinct claim or claims, upon which the patent must stand. A provisional protection for an invention can be obtained which extends to nine months, when the specification need not be so full as for the patent, and no drawing is required. The English and French patents are quite distinct and separate matters, the only connecting-link being that, according to a law known as "the Convention," an English patentee has six months' priority should he elect to apply for a French patent. In the matter of foreign patents it is advisable to consult a patent agent.—R. & C.

Polishing and Soldering Aluminium.—ROUGE BUFF (*Battersea*).—Finished goods made of aluminium are polished on a dolly, or mop, revolved in a lathe, and charged with crocus; then finished with Sheffield lime, much in the same way as nickel. The dolly is made with soft linen or calico rags. The following white solders are said to be used for soldering pure aluminium:—(1) Aluminium, 20 parts; zinc, 80 parts. (2) Aluminium, 10 parts; grain tin, 90 parts. (3) Zinc, 5 parts; tin, 2 parts; lead, 1 part. The surfaces to be soldered must be scraped clean, and solid paraffin used as a flux. The following coloured solders are said to be used for soldering aluminium bronze: Hard.—Gold, 88·88; silver, 4·68; copper, 6·44 parts. Medium.—Gold, 54·40; silver, 28·60; copper, 18·00 parts. Soft.—Gold, 14·30; silver, 57·10; copper, 14·30; brass, 14·30 parts. The brass for this last solder is to be made of copper 70 parts and tin 30 parts.—G. E. B.

Electric Bell Battery.—SUPPLEMENT.—The Bunsen battery is altogether unsuitable for electric bell work. The Leclanché has been the battery in general use for this work for several years past. The Gassner dry battery deserves all the praise you may have heard about it. The cells are 4s. 6d. and 5s. each, obtainable in London from Messrs. Mayfield, Cobb, & Co., 41, Queen Victoria Street, E.C.; and in Leicester from Messrs. T. Gent & Co., Faraday Works, Braunstone Gate. An illustrated series of articles on electric bells is now in course of preparation for WORK.—G. E. B.

Bamboo Dealers.—BAMBOO (*Wolverhampton*).—F. Westbury and Benjamin & Co., Great Dover Street; Brandenburg, Queen Street, Finsbury; Ellmore & Sons, City Road—all in London—are dealers in bamboos. See answer to O. P. Q. in No. 14. I do not understand the part of your question asking how to order, I can only say it must be done in the same manner as any other business transaction, either personally or by letter.—D. A.

Oil in Planes.—J. B. (*Rochdale*).—You cannot get the oil out without spoiling them, or at least running great risk of doing so. The blocks are purposely oiled, both in order to improve them for working and to preserve the wood in perfect condition, so that I am at a loss to understand why you want to eliminate it. Few, if any, practical mechanics would regard a wooden smoothing plane as complete till it had been saturated with oil, a very common plan being to fill the hole with oil, after stopping it on the face, and leave it till absorbed. If the planes you wish to free from oil are new, and you find them too greasy to handle pleasantly, remember that time will effect the cure. I have said this to show the folly of trying to eliminate the oil; but if you are still determined to try you might keep the planes in a warm place to cause them to "sweat."—D. A.

Lettering Backs of Books.—J. S. (*Barnsley*).—Assuming that your books are leather bound, beat the white of an egg and a few drops of vinegar to a froth; let stand some hours, and then draw off the clear glaire. Damp back of book with vinegar; when dry, give two coats of glaire; dry again, and place gold leaf carefully upon portions to be printed. Heat your letter stamps just so hot that water will not fizz, and apply with steady, firm pressure. Remove surplus gold with cotton wool.—OPIFEX.

Cleaning and Repolishing Dirty Tables.—HAIRDRESSER (*Great Dunmow*).—So much depends on the condition of the tables that one would almost require to see them before expressing a decided opinion on the best way to clean them; but I trust the following hints may be useful to you:—If the dirt and grease are merely superficial, and the wood has a fair amount of French polish on it, you cannot do better than make use of cleanser and reviver in one, composed of the following ingredients—vinegar, linseed oil, and glaze, or a small quantity of French polish. The exact proportions are not important; but, to guide you, say one pennyworth of each of the two first to half a pint of glaze, or half that quantity of French polish. A little of this cheap mixture goes a long way. Use it with a rag, and as often as you like, but continue the rubbing till the surface of the wood is glossy and dry. If the things have not been French polished, but merely oiled or waxed, you may wash them with warm water and soap; but don't saturate the wood. You must afterwards, when quite dry, either polish with a mixture of wax and turps or with French polish. The former is made by melting wax and adding turpentine, so that the mixture, when cold, is of a workable consistency. Use it sparingly, with an unlimited quantity of "elbow-grease." For French polishing proceed exactly as if the work were new, but unless you have some knowledge of the subject, you are hardly likely to make a good job with this finish. To tell you how to do so in the best manner for the various woods you name would require a page or two of WORK; but if you will tell me any one you particularly want to polish, I will direct you with pleasure. I may tell you that papers on French polishing will appear in due course. If the dirt and grease are thoroughly ingrained, the only way will be to plane or scrape off the surface till the clean wood is reached; but if any of your table tops are veneered be careful what you do, or you will go through the veneer.—D. A.

Column Support in Building.—THANKFUL (*Cinderford*).—The request made by a reader of WORK, under the *nom de plume* THANKFUL, is, I think, in part scarcely suitable for the paper. I take it that WORK is intended as a medium for general information; the main question involved in this query becomes personal. For general information I give the following figures, taken at random from various churches, giving the heights from floor to wall plate, the span of arch between nave and aisle, the height of columns and the

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diameter of columns, and, to a certain extent, must leave you to decide whether the arch you mention is supported by a column of sufficient strength or not:—

	Height to wall-plate.	Span of arch.	Height of column.	Diameter of column.
	ft. in.	ft. in.	ft. in.	ft. in.
1 ..	56 0	11 6	12 0	3 0
2 ..	36 6	22 6	7 0	3 6
3 ..	45 0	7 6	14 6	1 6
4 ..	34 0	11 0	11 0	1 9
5 ..	35 0	16 0	9 6	2 0
6 ..	42 0	12 6	10 9	2 6
7 ..	48 0	16 0	13 0	3 0
8 ..	47 0	14 0	13 0	3 0
9 ..	63 0	15 0	17 0	3 0
10 ..	33 0	13 0	16 0	2 6
11 ..	34 0	10 0	10 0	2 4

In the case you allude to the idea is, I suppose, to avoid creating too many or too ponderous obstructions in the structure, which must of necessity prevent some of the congregation from obtaining a general view. I can conceive of no other reason. From the above figures you will see that the column you mention has a diameter equal to No. 3, whilst the span is 16 ft. 9 in. as against 7 ft. 6 in. Strength of construction is made subservient to expediency; this is a mistake, certainly, in buildings which, like Shakespeare, are not for a time, but for all time. Personally, I should not run so close to possible danger; structural strength and stability should take first not second place. In answer to your second request, if the architect you employed has, to the best of his knowledge, fulfilled his part of the contract, how can you expect him to pay for an alteration you deem requisite, but which he, by his action, plainly does not? You must first prove a fault to exist. He evidently considers the building strong enough, for no sensible man would risk his reputation and practice by running a risk of which he was fully aware; and the collapse of a building under such circumstances must, in ninety-nine out of a hundred cases, mean collapse of business also. Nevertheless, he may, from want of sufficient data, make a mistake the result of which would be disastrous. The builder is in no way responsible for the work beyond fulfilling the scheduled requirements. The probabilities are that those who desire the alterations must also pay the piper.—J. M.

Binding Covers for WORK.—W. S. W. (*Hunningley*).—A binding case will be prepared by the publishers of WORK to contain a year's numbers, and the price of it will be about 1s. 3d.

Joiners' Composition.—There may be many in use, but the best I have tried is quite waterproof, and sets at once as hard as hard wood. It is called "choucha," and may be bought at Deed's leather warehouse, High Street, Bloomsbury, London. I think it is about 2d. or 4d. per ounce. It seems to be a mixture of gutta percha and shellac. I have used it in cabinet work, or to repair fractures. It is warmed over flame or by heat, and applied with a palette knife very thinly spread. Better also heat the parts to be joined.—J. C. K.

Plumbing Examinations.—J. G. (*Brighton*).—To answer fully the questions asked by J. G. would effectually destroy the chief object of these examinations, which are meant to test the capacity of candidates who wish to be enrolled as registered plumbers. My advice to J. G. is to apply to the clerk to the Plumbers' Company, No. 1, Adelaide Buildings, London Bridge, E.C., for the printed form furnished by the company to all plumbers who desire to be registered. This form contains all needful preliminary information.—G. S.

Painting on Zinc.—W. G. (*Brixton*).—I have painted on zinc both for indoor and outdoor decorative work, and would advise that for either the zinc should first be rubbed over or scoured with dry sandstone or grit, to create a roughness to hold the paint. For my indoor work (which I find stand remarkably well) I have used tube oil colours worked up with gum dammer varnish as a medium. The latter I prepare by dissolving the gum in turps and straining through muslin. A "dammar varnish" is sold which is probably much the same as mine. I have not found work thus done either peel off or blister. It is more difficult to make outdoor work stand than indoor. Some done by me seven years since without roughening the zinc and with gold size only as a medium has almost perished. The sun, and not rain or frost, is our worst enemy. I find that metallic colours, such as flake white, stand best. For merely useful outdoor work, such as spouting, the zinc is best *not* painted.—C. C. C. [As regards sizes and prices of rough articles in papier-mâché, W. G. is referred to Messrs. McCallum & Hodson, Summer Row, Birmingham.—S. W.]

Index to WORK.—R. H. P. (*Broadstairs*).—Certainly an index will be issued at the completion of each volume of WORK.

More Talk than Work.—DA CAPO.—You ask if there is not more talk than work in WORK. Assuredly not! How could you possibly learn any trade or art if your instructor held his tongue, and did nothing more than look at you and point and draw diagrams? In all teaching conveyed by the medium of paper, type, and ink, it is necessary to be as explicit as possible, even though the tuition given sometimes assumes the form of a lecture.

French Polishing.—A CONSTANT READER OF "WORK."—Information on French polishing will be given at no distant date.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

E. M. (*Madrid*) writes:—"If you know of a practical book on the treatment of ivory, mother-of-pearl, tortoiseshell, and similar materials for such work as fan making, be kind enough to mention it and possible particulars in 'Shop.'"

Water Power.—J. L. (*London, W.*) says:—"Will any reader oblige by explaining in WORK the reason why a turbine is of more power with the same amount of water available than an overshot or back-shot water-wheel? I can scarce understand its action."

Flour Paste Souring.—J. R. (*Skerrics*) writes:—"Would any reader of WORK kindly inform me of some means for keeping flour paste from souring and getting bad, so as to enable me to keep it on my office desk for use, instead of gum?"

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Polishing Oak Floors.—D. A. writes in reply to H. N. (*Bexley Heath*), see page 174:—"Beeswax and turps, if properly applied, give a good polish, but not so brilliant as varnish. Probably the cause of failure is an insufficient application of elbow grease and a too liberal use of the wax polish. If a bright polish is wanted, use brown oak varnish."

Wood Colouring.—D. D. writes in reply to OX GALL (see page 174):—"Take vandyke brown, ¼ lb., ammonia, ½ pint. Mix and reduce with water."

Glaze for Finishing French Polishing.—D. D. writes in reply to W. H. B. (see page 174):—"Put 2 oz. of benzoin into ½ pint of methylated spirits. When the gum is dissolved strain through muslin."

French Polishing.—G. B. P. (*Birmingham*) writes in reply to T. A. (*Belfast*), see page 174:—"You should always varnish your fretwork, using no oil whatever, as the latter would work out in time. I polish my wood in the flat before cutting out, and then touch up with the brush. If you would let me know fully what you want to know, I would (with our editor's kind permission) let you know with pleasure, either privately or through WORK. Editor has my address."

Solidifying Petroleum Oil.—H. B. S. (*Liverpool*) writes in reply to W. H. (*Liverpool*), page 110:—"It is not possible to solidify common commercial petroleum oil."

Solidifying Petroleum Oil.—P. W. S. (*Poplar*) writes:—"If W. H. (*Liverpool*) will name the purpose to which the solidified oil is to be put, I can help him, either in 'Shop' or privately." [Will W. H. (*Liverpool*) kindly notify if he desires the assistance offered by P. W. S. (*Poplar*), and in which way?—ED.]

Joiner's Composition.—J. M. (*Louth*) writes:—"In answer to question by F. B. (*Guernsey*), page 158, I shall be very pleased to give him the receipt for which he asked, as follows:—Equal parts of beeswax and resin coloured with red ochre to suit the work. Red ochre for mahogany, brown umber for walnut; white wax use for ash, and other light woods. F. B. will have to be careful how he uses the red ochre, as a small quantity goes a long way; better melt the beeswax and resin, and add ochre to suit the job. Being a practical cabinet maker myself, shall be pleased to answer such correspondents as F. B. as far as lays in my power, not only because I am very pleased with WORK, but because I am pleased to help any one that is anxious to improve himself. I, myself, am very pleased with 'Tips for Tyros,' the tip about picture-frame corners being very useful to me. I hope you will have a great success with WORK, etc."

Etching on Steel.—FEN MON writes, in reference to the reply given to EXCELSIOR by G. E. B., in No. 8, page 125, under this heading:—"The powder EXCELSIOR means will be, I have not the slightest doubt, sulphate of copper, commonly known as blue stone or blue vitriol. This, when dissolved in water, particularly if acid is present, will itself dissolve out iron or steel, and deposit in its place, as a spongy brown crust, metallic copper. The equation, leaving out the *water* of solution and crystallisation, is—

$$\left\{\begin{array}{l} Cu\,SO_4 + Fe = Fe\,SO_4 + Cu \\ \text{Cop. Sulph.} + \text{Iron} = \text{Iron Sulphate} + \text{Copper.} \end{array}\right\}$$

EXCELSIOR would get better results if, instead of soap, which is liable to dissolve away with water in fine parts, he heated the steel moderately, and rubbed it over with beeswax. Etchers have, instead, a complicated mixture for a novice to make. Then, with a sharp pointer or pen, be sure to expose the metal. If, when it has stood by, EXCELSIOR does not think he has cut deep enough, before he takes off his wax he may change his solution for fresh, as it will only act so long as there is $Cu\,SO_4$ left in it. If he wants to etch other metals as well, nitric acid is best, as it will attack almost all metals, gold and platinum, etc., being about the only exceptions; but it is not a nice acid to use, staining the hands, and besides, very noxious fumes arise from it. I hope this will explain matters to the satisfaction of EXCELSIOR."

Fretwork Patterns.—F. C. (*Cheadle*) writes in reply to W. E. M. (see page 174):—"Seeing in WORK for June 1st an inquiry asking where the work on fretwork alluded to in that publication can be got, I have got the work, and have succeeded in getting some very pleasing patterns from it. It is published by Adams and Bishop, successors to Henry T. Williams, 46, Beekman Street, New York, price 50 cents. The copy that I have was bought at Messrs. Gleave and Sons, Oldham Street, Manchester.

Trade Notes and Memoranda.

THE new battleships for the navy, eight in number, will each carry 4,550 tons of armour, whose maximum thickness will be 18 in. The principal armament will consist in each vessel of four 67-ton breechloading guns, having a calibre of 13½ in., and firing a shot of 1,250 lbs. weight, with a charge of 630 lbs. of powder. Besides these, each ship contains a secondary armament of ten 6-in. quick-firing guns, besides several smaller ones. We have it on the authority of Lord Armstrong that these 6-in. guns will pierce the armour of most of the warships now afloat.

A NEW line of railway between Liverpool and Manchester was opened on the 1st of June. There are already two lines, the Cheshire and the North-Western, connecting those cities, so that some rivalry may be anticipated. The new route runs from Victoria Station, Manchester, through Pendleton and Atherton, and passes just outside Wigan to join the present Lancashire and Yorkshire line from Wigan to Liverpool at Pemberton. Its total length will be 35 miles against 34 miles by the Cheshire line, and 31½ miles by the London and North-Western.

A PAPER on "The Origin of Bronze" was read at a recent meeting of the Paris Academy of Sciences by M. Bertholet. The author analysed specimens of metal from a statuette from Tello in Mesopotamia, and from the sceptre of the Egyptian King Pepi I., sixth dynasty, both dating back to about 4,000 B.C., and found them to be pure copper. He, therefore, argues the existence of a copper age between that of stone and of bronze, and thinks the latter is not more than fifty or sixty centuries old.

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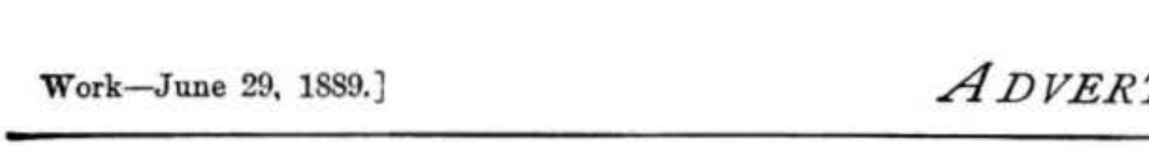

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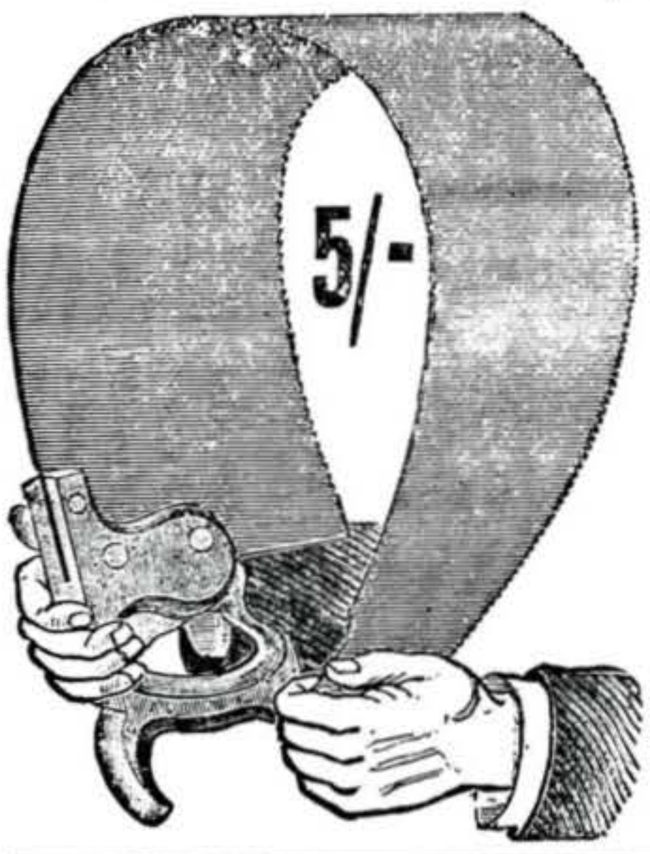

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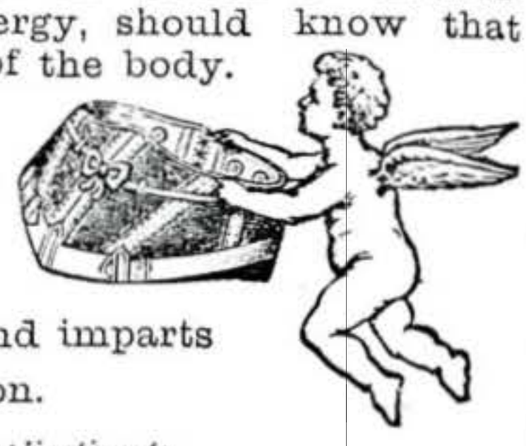

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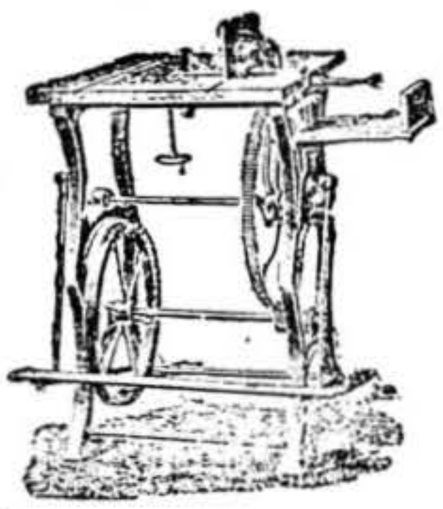

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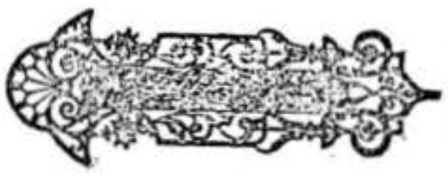

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